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Profitable Premixed Concrete Plant *Has* Complete Equipment

Waukesha, Wis., Contractors Supply Concrete on Quality-Controlled Basis—Aggregates Conveyed from Commercial Stock-Piles—Trucks Equipped with Agitator Bodies

AN unusual and economical method of handling aggregates is the outstanding feature of a well-designed ready-mixed concrete plant in Waukesha, Wis., in operation since May, 1930, under the ownership and management of Cayll & Barrett, contractors.

Convey Aggregates from Commercial Stock-Piles

The unique arrangement for conveying aggregates is made possible because of the location of the ready-mixed concrete plant near the stock-piles of Waukesha Lime & Stone Co. One of the stock-piles, as well as the conveyor and the conveyor tunnel, may be seen in the general view (Figure 1) and in the close view (Figure 2).

The stock-pile near the mouth of the tunnel is crushed gravel. This material, as brought from the pits, runs about 65 per cent larger than ¾ in., and these larger sizes are crushed to ¾ in. maximum. The sand, in the second stock-pile, not shown in the illustrations, is obtained from the pit near the plant site. Both aggregates are washed material.

To simplify the handling of aggregates from the stock-piles to the ready-mixed concrete plant, a reinforced concrete flat-topped tunnel, 135 ft. long, was built so as to extend under the piles of sand and gravel. Adjustable openings in the top of the tunnel feed the sand or gravel directly to a 24-in. belt conveyor, which in turn delivers the material to a 20-in. sloping belt conveyor 220 ft. long. Both conveyors are of Rex-Stearns manufacture.

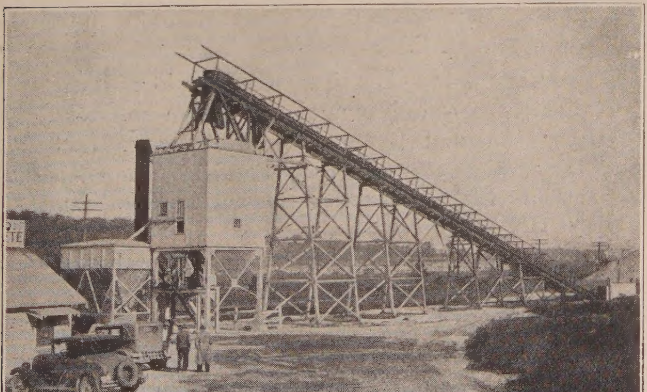

Figure 1. General view of Cayll & Barrett's ready-mixed concrete plant. Note tunnel at right, under stock-piles of aggregate

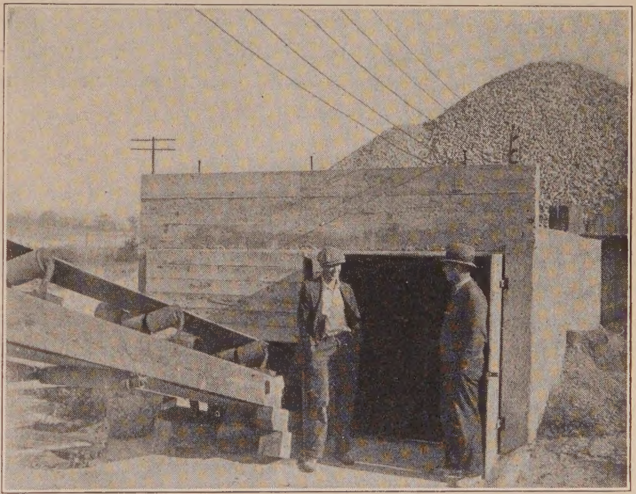

Figure 2. Entrance to tunnel, from which aggregates are conveyed to mixing plant

Storage Bins of Liberal Capacity

The sloping belt conveyor delivers the aggregates to a 3-compartment bin of 110 cu. yd. capacity, through chutes fitted with gates to direct the material to any one of the compartments.

Cement is delivered in bulk by truck and stored in a bin of 500 bbl. capacity, from which it is elevated vertically through a Rex-Stearns elevator and chuted to the measuring device over the mixer. All bins are of Butler manufacture.

The batches of concrete are proportioned by weight, the aggregates being measured by three separate beam scales. The cement is handled individually and is measured by a beam scale. All scales are equipped with telltale devices, and can be adjusted readily to take care of changes in proportions.

In proportioning the concrete, the operator utilizes the water-cement ratio method of control, and the proportions between fine and coarse aggregates are determined on a scientific basis. The words "Ready-Mixed Quality Concrete" appear in prominent letters on the truck equipment and over the plant office.

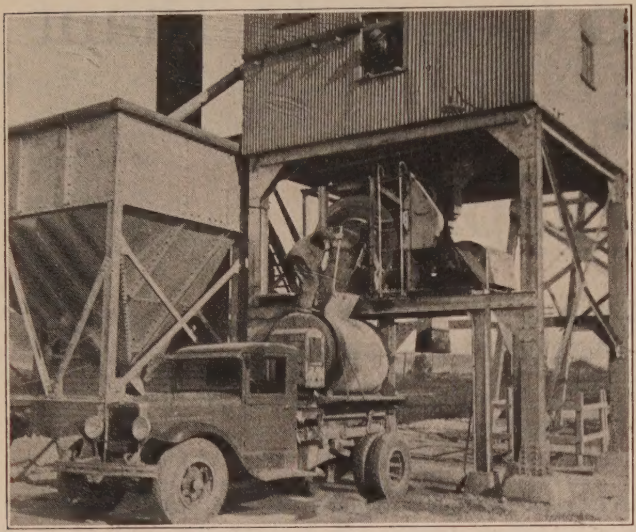

Figure 3. Truck equipped with agitator body taking on load of concrete

Mixing and Transporting Equipment

The mixer is a 1-yd. Rex 28-S, manufactured by the Chain Belt Co., and the agitator truck equipment consists of two 3½-ton International trucks surmounted by Clinton agitator bodies of 2 cu. yd. capacity.

The plant has turned out as much as 250 cu. yd. in a day. On one occasion the plant operated continuously for 30 hours, for a contract where concreting operations had to be carried on from start to finish, without interruption. To provide for night operation in emergencies of this character, the plant and the adjoining truck drives and approaches are well lighted.

Sell to Small and Large Contractors

The customers of the ready-mixed concrete plant include the construction department of the city and of several public utilities, and both large and small contractors.

The plant management in this instance has been more successful than the average, in selling to small contractors of the class who build sidewalks, small foundations, and similar work. The sales talk to these people is mainly based on the convenience of buying concrete ready mixed.

No special effort is made to disseminate information to customers regarding quality control, or the advantages of buying concrete on a strength basis. The management feels that these matters are well understood by the larger contractor customers, by the city engineer, the city building inspector, and the engineers in the construction departments of the public utilities. In consequence, when a less-informed customer orders 1:2:4 concrete it is assumed that what he really has in mind is 2,000-lb. concrete. On this order the materials are then proportioned to produce concrete having a 7-day strength somewhat above 2,000 lb. per sq. in.

Avoid Competition Against Customers

Cayll & Barrett, who have been in the contracting business in Waukesha for some years, built the ready-mixed concrete plant partly as a means of supplying their own requirements. Since establishing this plant they have continued their contracting work, but in no case do they offer competitive bids against customers.

Supply Dry-Batched Materials

Dry-mixed batches are also supplied to customers, through the use of the regular weight-measuring equipment of the plant. Instead of discharging the materials into the mixer, the turn of a gate diverts it into a "pantsleg" on the side opposite the mixer discharge, and from there into the waiting truck.

Small Personnel

A characteristic feature of all modern and well-equipped ready-mixed concrete plants is seen in this plant, in the small amount of operating labor required. Aside from the truck drivers, the plant itself is operated by the proprietors, A. Cayll and E. P. Barrett. Obviously, this is possible only because of the completeness of the labor-saving equipment installed.

As pointed out by a plant manager in a previous article in CONCRETE,[1] the need for holding plant employes down to a minimum arises from the great fluctuation in the demand for concrete. The plant with three or four operators will have non-productive wages to pay during the frequent periods of low demand when there is little work to occupy the men, and the consequent overhead becomes a burden.

The Waukesha plant and truck equipment represent an investment of about $35,000.

Coming Conventions

December 10-11—Highway Research Board, National Research Council, eleventh annual meeting. National Academy of Sciences auditorium, Washington, D. C.

January 9-15—American Road Builders Association, twenty-ninth annual convention and road show. Municipal Airport Building, Detroit, Mich.

January 19-22—National Crushed Stone Association, fifteenth annual convention. William Penn Hotel, Pittsburgh, Pa.

January 25-26—National Ready-Mixed Concrete Association, second annual convention, William Penn Hotel, Pittsburgh, Pa.

January 27-29—National Sand and Gravel Association, sixteenth annual convention, William Penn Hotel, Pittsburgh, Pa.

March 1-4 — American Concrete Institute, twenty-eighth annual convention. Wardman Park Hotel, Washington, D. C.

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[1] June (1931) issue of CONCRETE, page 11.

Economical Distribution of Concrete by Portable Belt Conveyors

Conveyors Also Remove Excavated Material and Rubbish—Driven by Electric Power—Two Mixers Supply 1½ Cubic Yards Per Minute

THE use of 1,600 lin. ft. of portable belt conveyors and 1,200 lin. ft. of permanent conveyors for the economical distribution of concrete is the outstanding feature of the construction of the substructure of the new postoffice building in Chicago, a building that is to occupy a ground area 344 by 796 ft. in general dimensions, with a total floor area of about 2,300,000 sq. ft.

Many of the belt conveyors, which are of Barber-Greene manufacture, are the same units that were employed on the Merchandise Mart,[1] the Morrison Hotel addition, the Transportation building of the Century of Progress Exposition, and the 126th Street sewage disposal plant, all located in Chicago and all built by the same general contractor. In the construction of the Merchandise Mart, in fact, these portable concrete conveyors were used for the first time.

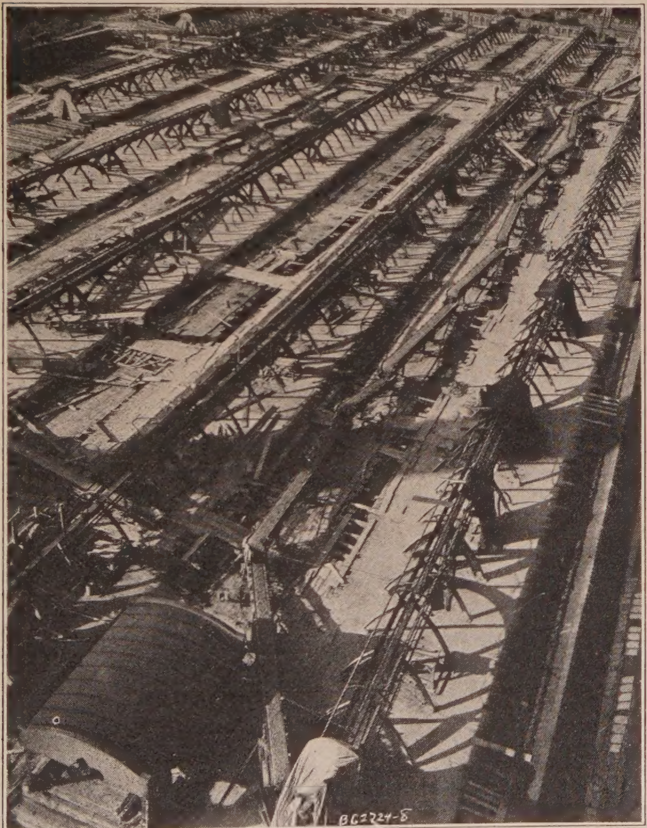

Figure 1. Construction site of Chicago's new postoffice building, showing the construction deck under which 200 trains pass daily

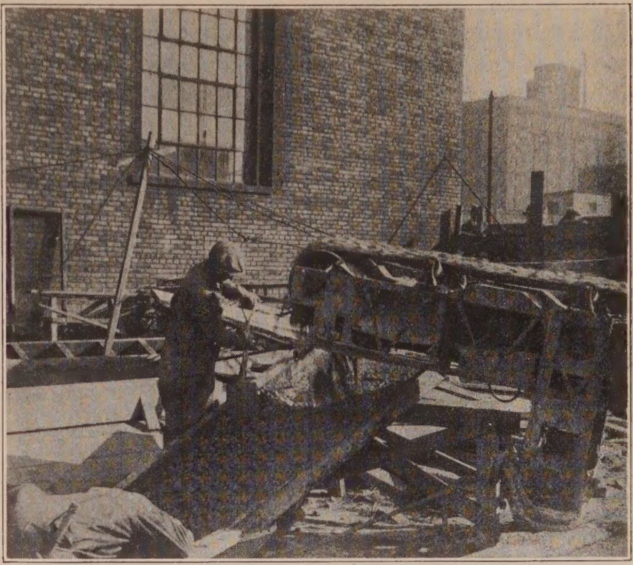

Figure 2. Discharge end of last of long series of portable concrete conveyors

The portable units employed on the postoffice contract range in length from 20 to 60 ft. The permanent conveyors are from 100 to 400 ft. long, and are bolted together to form a continuous belt conveyor. The portable conveyors are easily shifted about by a few men of the concrete placing crew. They are supported on runways of the type usually built for distribution of concrete by buggies. Electric power for their operation is supplied

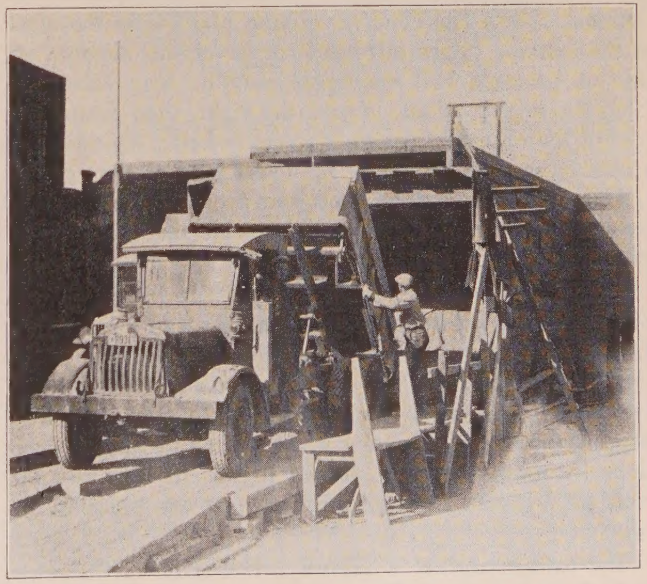

Figure 3. Delivering premixed aggregates and cement to the concrete mixing plant

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[1] See CONCRETE, October, 1929, pages 13 to 16, and September, 1930, pages 13 to 15.

by power lines that are strung along the lines of conveyors.

Convey Concrete Long Distances

On the postoffice project the substructure includes 304 concrete caissons founded on bedrock, approximately 110 ft. below the mean level of Lake Michigan. The concrete mixing plant is located near the northwest corner of the construction site, so that some of the concrete must be conveyed for distances as great as 1,000 ft. or more.

Supply 1½ Cubic Yards Per Minute

The mixing plant consists of two 1-yd. mixers of Koehring manufacture, each mixer discharging into the same chute and hopper, from opposite sides. A vertical-lift hopper gate releases the freshly mixed concrete to the first portable belt conveyor unit, other units being placed as required to reach the point of final deposit. Figure 1 shows a view of the construction site as it existed in October, 1931. The concrete mixing plant is in the shed in the extreme upper left-hand corner of the picture. A line of portable belt conveyors may be seen extending from the mixing plant, toward the right, then downward toward the observer, where concrete is being deposited in a caisson near the middle of the lower edge of the picture.

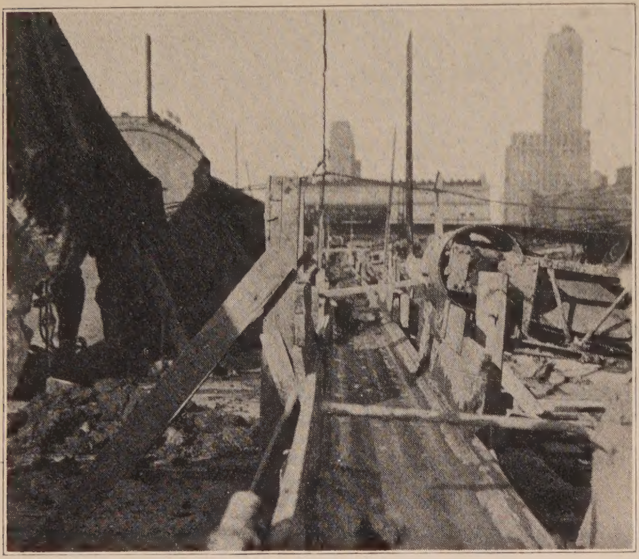


Figure 4. Portable conveyors serving each caisson well deposit excavated material on continuous conveyor, which carries material to river scow

The discharge end of each conveyor is fitted with a scraper that cleans the belt and avoids the necessity of washing the belts at the end of a run.

Figure 2 shows a close-up view of the discharge end of the last conveyor in the line, and the short chute that directs the concrete into the metal hopper and spout over the caisson well. The spout of this hopper is about 15 ft. long. The concrete drops from the spout to the place of deposit, the end of the spout being shifted to various positions by means of ropes lashed to it. In this way the concrete is prevented from piling up at one place in the caisson.

The caisson shown in Figure 2 is 4½ ft. in diameter, requiring 16 cu. ft. of concrete to the foot of height. With the conveyors delivering 1½ cu. yd. of concrete per minute, the rate of concreting averages 2½ ft. of vertical fill per minute.

Deliver Dry Batches to Mixing Plant

The concrete in the caissons is a 1:1:2 mixture of cement, torpedo sand and crushed stone, delivered to the mixing plant in flat-bottom dump trucks in dry-mixed form. A separate receiving hopper is provided for each of the two mixers, and from the hoppers the premixed material is elevated to the mixers by two of the portable conveyor units which have been installed for this special purpose. The cement and aggregates are delivered into Johnson bins and weighed by batches by an automatic weighing device. Tanks above the mixers supply measured quantities of water to the batches.

Through the use of premixed concrete materials, the need for maintaining aggregate stock-piles is completely eliminated. The trucks that haul the mixed aggregates and cement make deliveries in accordance with a definite schedule, so that the mixer is always supplied.

The mixing plant is shown in Figure 3, with a truck in the act of delivering premixed materials.

Other Uses for Conveyors

The use of the conveyors is not confined to the distribution of concrete. Aside from the two conveyor units used for delivering cement and aggregates to the mixers, many of the units were put into service to remove the excavated material from the caisson wells to a mud scow in the Chicago River. One conveyor unit was placed at each caisson well where excavating was in progress. These units discharged directly to one of the permanent belt conveyors, as shown in Figure 4. The continuous conveyors, in turn, carried the excavated material to the scow. In order to reach the scow with the conveyor, a space was cut through the old parcel post building, located next to the river, and which is being incorporated into the new structure.

Removal of Rubbish

Rubbish will be removed in a similar manner as the construction work proceeds, and in the final clean-up. In consequence, the utility of the conveyor equipment is extended considerably beyond its primary use as a concrete distributing system.

The general contractor on the Chicago postoffice project is the John Griffiths & Son Company, of Chicago, with Bruce Gordon in charge as superintendent of construction. The work shown in Figures 1, 2 and 4 is being conducted on a construction deck that covers the entire building site, without interruption to nearly 200 trains that daily pass underneath the deck.

Central and Truck-Mixed Concrete on Road Builders' Program

Central and truck-mixed concrete will occupy a prominent place in the portion of the American Road Builders' Association convention program devoted to concrete. The 1932 convention will be held at the Municipal Airport Building at Detroit, January 9 to 15, the concrete session taking place on January 12.

Other reports will deal with the design and construction of pavements, bases and highways, and construction equipment.

Automatic Temperature Control in Highway Laboratory Moist Room

Tennessee Highway Department Adds Valuable Feature to Physical Testing Laboratory—Details and Operation of Cooling Unit

By E. W. BAUMAN
Engineer of Tests, Tennessee Department of Highways,
Nashville, Tenn.

THE Tennessee Highway Department has recently installed in the laboratory a moist room equipped with automatic temperature and humidity controlling devices which provide a constant temperature of 70 deg. plus or minus 2 deg., and a humidity of 98 deg. plus. The room is 17.5 by 15.5 by 10.5 ft., providing ample storage space for all mortar and concrete specimens required by the Division of Tests to carry on its program of cement testing and concrete research work. Four concrete tanks, 3 by 7 ft. by 6 in. deep, arranged in tiers, in which continuous circulation of water is maintained, provide storage of briquettes and 2 by 4-in. cylinders. The room is insulated with 2-in. cork, waterproofed by dipping in an asphalt mastic, then lined with Barrett "Protecto" tar. The floor insulation is sandwiched between two 4-in. layers of concrete.

The Cooling Unit

The cooling unit consists of two 86-C Warren & Larkin aluminum plate coils charged with SO_2 and served with two 1-h.p. water-cooled compressors. The heater consists of copper strips connected in series, capacity 4 kilowatts; heater and coils are suspended from the ceiling and contained in a sheet metal housing with an electric fan which pulls the air current through the coils or over the heater and passes it through a spray at the opening of the housing, providing the circulation and humidity for the room.

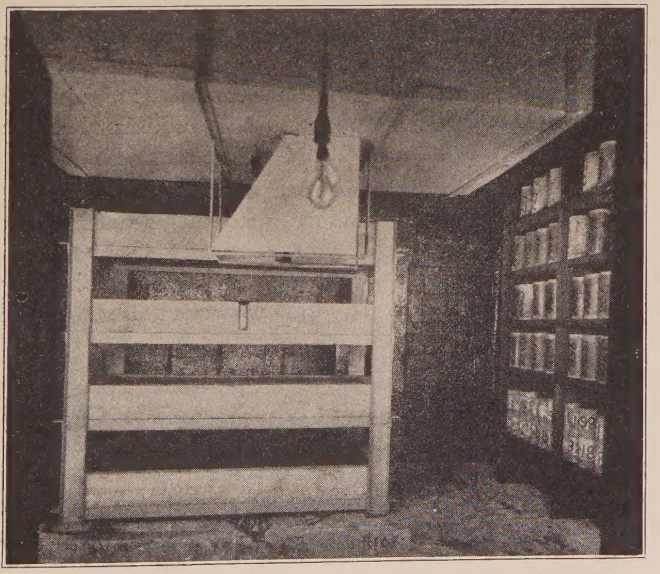


Figure 1. Housed-in cooling unit suspended from ceiling of moist room

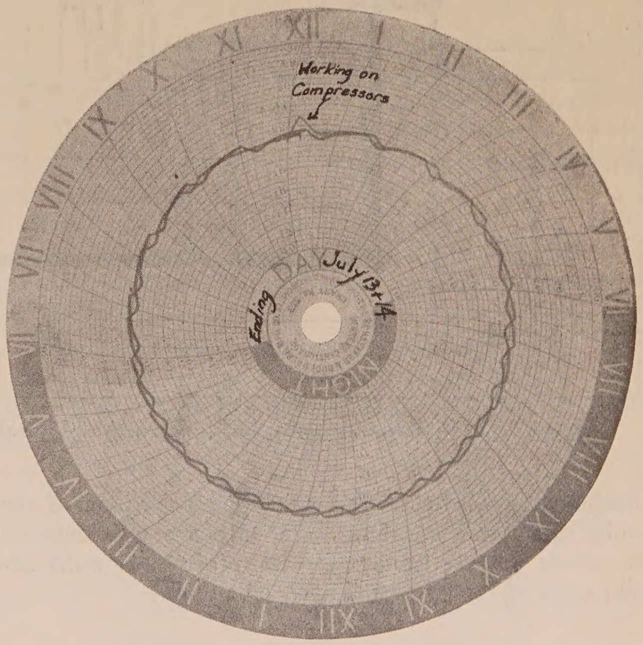


Figure 2. Temperature range in moist room during 24 hours

Three thermostatic mercoid controls are employed to keep the temperature constant, adjusted so that the temperature of the room at 71 deg. F. actuates a cut-in switch through a relay and operates one compressor. At 72 deg. F. the second compressor is cut in. When the temperature drops to 69 deg. F. the heater is turned on. Both the compressors and the heater are idle as long as the temperature of the room is 70 deg. F.

Room Built Within Laboratory

Figure 1 is a view of the housed-in cooling unit suspended from the ceiling of the moist room. Figure 2 is a graph from the temperature recording instrument showing temperature range during a 24-hour period when the outside temperature was an average of 80 deg. F. and a

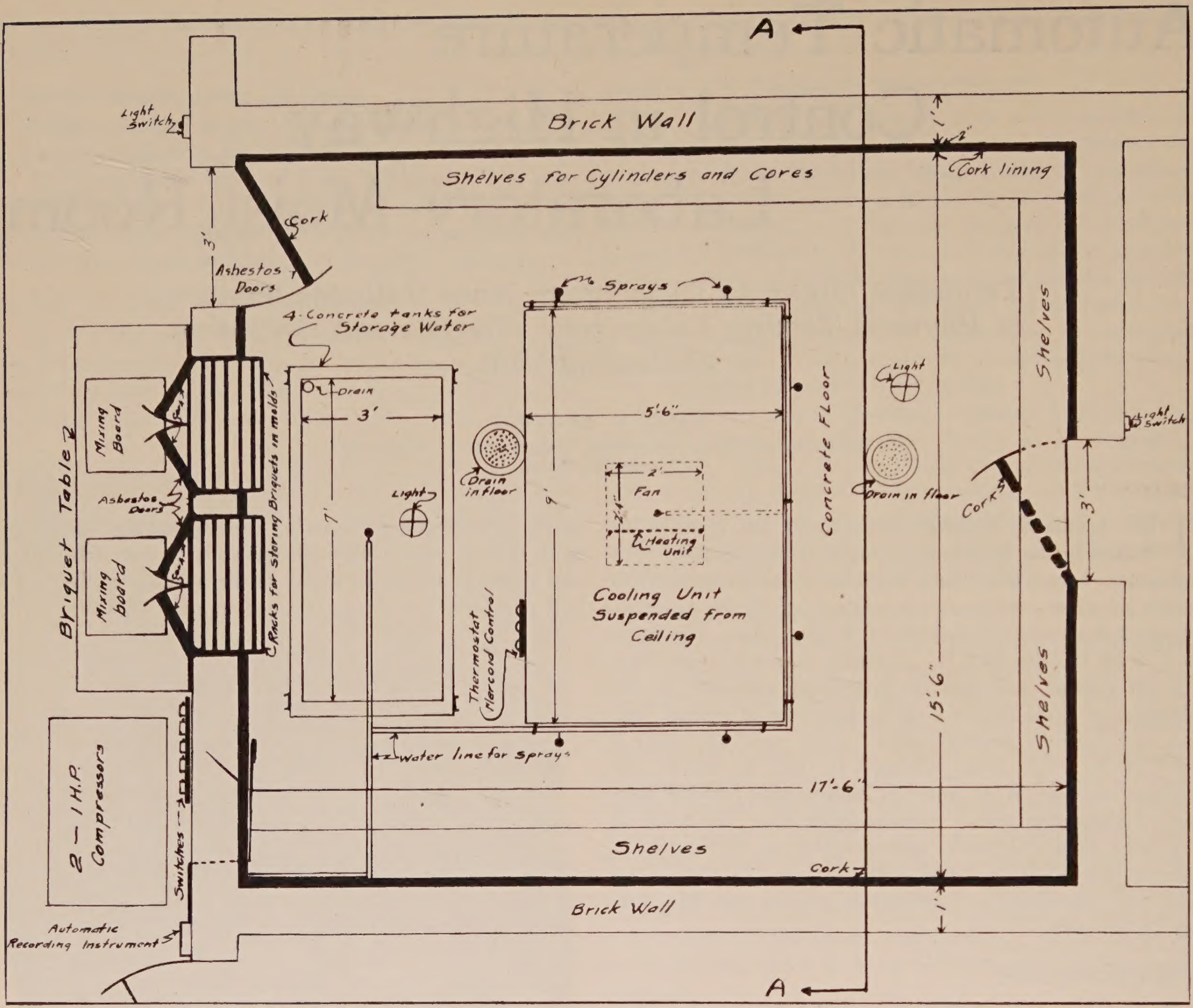


Figure 3. Plan of moist room, built within the physical testing laboratory of the Tennessee Highway Department

maximum of 95 deg. F. Figure 3 shows the plan of the moist room, which is built with only one wall exposed to outside weather conditions. The other three walls adjoin parts of the physical testing laboratory.

Brick Resurfacing of Old Concrete Proves Error

Chicago Tribune Reports Accident Record on Five-Mile Stretch in Illinois

The danger of building highway pavements of types of material with which motorists are not familiar is being demonstrated on a 5-mile stretch of the Lincoln highway, near Matteson, Ill.

This stretch of road was paved with concrete many years ago, under design and construction methods now considered antiquated. The slab had no center expansion joint and the outer edges were not thickened or reinforced. Part of the concrete pavement was 16 ft. wide, and the remainder was 18 ft.

This road was scheduled to be resurfaced with brick, as a part of the 1931 construction program, over protests that it would cost no more to widen the road to 40 ft. with concrete. The protests went unheeded and the brick resurfacing was placed. The state highway department has now resurfaced this road with tar and gravel.

An article in the *Chicago Tribune* of November 1 reports that as many as fifteen wrecks a day have occurred on this 5-mile road during rainy weather. One instance is described where eight cars slid into a collision because of the inability to stop on the wet pavement.

In the construction of this road a thin coat of asphalt filler was applied to the surface, with the idea of filling the joints between bricks. The coating of asphalt, according to the *Tribune*, is believed to be responsible for the slippery condition of the pavement during wet weather.

Experiments Being Made with Green Concrete Pavement

Green concrete pavements as an aid to driving are under test at the Pennsylvania State College of Optometry.

The green coloring, it is expected, will relieve eye strain in bright sunlight, at the same time giving the advantage of a light colored road by night.

Co-Ordinated Laws of Concrete Mixtures And Their Application

Basic Principles of Science and Practice of Concrete-Making Clarified—Procedure for Calculating Mixtures and Yield—Grading of Mixed Aggregate

By JOSEPH A. KITTS
Consulting Concrete Technologist, San Francisco, Calif.

Continuing with this presentation of simplified control of the quality of concrete, the procedure for making mixture calculations is given below.

The first installment stated the problem and gave the test procedure in determining the physical characteristics of aggregates.—The Author.

MIXTURE CALCULATION

Preliminary to the production of concrete on a project or at a commercial mixing plant, comprehensive tests of concrete of the local materials should be made to determine the constants in the equations of the six inter-related and inter-dependent laws of mixtures.

The criteria of materials and mixtures employed herein are those of Figure 12, "Design and Control of Concrete Mixtures" (Second Edition, January, 1927) and other data published by the Portland Cement Association. Under the present improved standard of cement quality and with rounded gravel aggregates of standard quality, these criteria are very conservative for the processes of technological control of production proposed.

Assume that a paving mixture is specified as follows, employing given aggregates and technological control of production:

4,000 lb. per sq. in. compressive strength at 28 days.
3-in. maximum (square hole) size of aggregate, and
3-in. slump.

Cement Content

The proportion of cement per cubic yard of concrete is determined by the author's Law of the Cement Content—

$$\log C = BK_s + A \qquad \text{(10)}$$

in which C is properly taken as the absolute volume of cement per cubic yard of concrete, K_s is the required compressive strength and A and B are constants, depending upon the maximum size of aggregate and slump, as given in Table 2 for the determination of cement content in pounds per cubic yard of set concrete, assuming cement of fairly uniform specific gravity.

Water Content

The water content is determined by the Abrams Law of the Water-Cement Ratio, which, when co-ordinated with the author's Law of the Cement Content, is—

$$W = FC(G - \log K_s) \qquad \text{(11)}$$

in which W is the proportion of water in a unit volume of concrete, and F and G are constants depending upon the character of the cement and aggregates and the skill of control.

For average commercial materials of standard quality, and where the water-cement ratio is carefully controlled by accurate determination and measurement of quantities of water, cement and aggregate, with proper correction for moisture content and absorption of the aggregate, the water content for the given criteria is—

$$W = 0.0125\ C\ (4.14613 - \log K_s) \qquad \text{(11a)}$$

in which W is the cubic feet of mixing water per cu. yd. of concrete, and C is the pounds of cement, as determined by Table 2.

Where the water-cement ratio is indifferently controlled, and where only approximate methods are used for determining and measuring quantities of materials, the water content equation for average quality materials is—

$$W = 0.01115\ C\ (4.14613 - \log K_s) \qquad \text{(11b)}$$

in which C is the cement content, as determined by Table 2 with a percentage increment (in lieu of skilled control) as given in Table 3.

The mixing water for the proposed mix is then—

$$W = 0.0125 \times 627\ (4.14613 - \log 4000) \quad \text{By (11a)}$$
$$= 4.264 \text{ cu. ft. per cu. yd. of concrete.}$$

Yield of Concrete

The Law of the Yield of Combinations is indicated by the work of M. Feret as—

$$Ky = \frac{Kv}{Av + Cv + Wv} = 1.0 \pm 0.015 \pm \qquad \text{(12)}$$

in which Kv is the apparent volume of set concrete and Av, Cv and Wv are the absolute (= apparent) volumes of aggregates, cement and water, respectively. Ky increases with the volume of entrapped air in the mix and decreases with the volume of cement dissolving into solution with the water. Ky should be determined by test. For well graded fluid or plastic mixtures, however, Ky is indicated within one-half of one per cent by Table 4.

The yield of concrete for the proposed mix is shown by Table 4 to be 0.980 for 627 pounds of cement per cubic yard of concrete.

TABLE 2

Cement Content for Rigid Control by Absolute Volume

Constants for Determining Pounds of Normal Standard Portland Cement per Cubic Yard of Concrete for Any Compressive Strength (at 28 days) for Given Slumps and Maximum Sizes of Aggregates, Employing the Equation, $\log C = BK_s + A$, and Based on the Water Content Equation $W = 0.0125\ C\ (4.14613 - \log K_s)$

(For average commercial gravel aggregates of standard quality.)

Standard Slump* in Inches		Maximum Size of Aggregate Square Hole Screen Sizes, Inches					Appx. Flow
		3/16	⅜	¾	1	1¼	
		Round Hole Screen Sizes, Inches					
		.225	.45	.9	1.2	1.5	
1	A	2.5236	2.4104	2.3200	2.2786	2.2474	
	B	.0001084	.0001224	.0001335	.0001386	.0001424	140
2	A	2.5497	2.4348	2.3400	2.2972	2.2648	
	B	.0001077	.0001221	.0001341	.0001395	.0001436	162
3	A	2.5758	2.4592	2.3600	2.3158	2.2822	
	B	.0001073	.0001224	.0001352	.0001409	.0001453	175
4	A	2.6019	2.4836	2.3800	2.3344	2.2996	
	B	.0001074	.0001232	.0001371	.0001432	.0001479	185
5	A	2.6280	2.5080	2.4000	2.3530	2.3170	
	B	.0001083	.0001250	.0001401	.0001467	.0001517	194
6	A	2.6541	2.5324	2.4200	2.3716	2.3344	
	B	.0001103	.0001282	.0001447	.0001518	.0001573	202
7	A	2.6802	2.5568	2.4400	2.3902	2.3518	
	B	.0001137	.0001331	.0001514	.0001593	.0001653	210
8	A	2.7063	2.5812	2.4600	2.4088	2.3692	
	B	.0001192	.0001406	.0001613	.0001700	.0001768	218
9	A	2.7324	2.6056	2.4800	2.4274	2.3866	
	B	.0001278	.0001519	.0001758	.0001858	.0001936	225
10	A	2.7585	2.6300	2.5000	2.4460	2.4040	
	B	.0001414	.0001695	.0001980	.0002098	.0002190	232
Opt. Slump**		8.6-in.	8.4-in.	8.0-in.	7.7-in.	7.5-in.	

		Square Hole Screen Sizes, Inches					
		1½	2	2½	3	6	
		Round Hole Screen Sizes, Inches					
		1.8	2.4	3.0	3.6	7.2	
1	A	2.2190	2.1780	2.1428	2.1178	2.0172	
	B	.0001459	.0001510	.0001553	.0001584	.0001708	140
2	A	2.2360	2.1935	2.1576	2.1316	2.0279	
	B	.0001472	.0001525	.0001571	.0001603	.0001734	162
3	A	2.2530	2.2090	2.1724	2.1454	2.0386	
	B	.0001490	.0001547	.0001595	.0001630	.0001768	175
4	A	2.2700	2.2245	2.1872	2.1592	2.0493	
	B	.0001518	.0001579	.0001629	.0001666	.0001813	185
5	A	2.2870	2.2400	2.2020	2.1730	2.0600	
	B	.0001559	.0001624	.0001677	.0001718	.0001875	194
6	A	2.3040	2.2555	2.2168	2.1868	2.0707	
	B	.0001617	.0001689	.0001746	.0001790	.0001960	202
7	A	2.3210	2.2710	2.2316	2.2006	———	
	B	.0001701	.0001780	.0001842	.0001890	———	210
8	A	2.3380	2.2865	2.2464	2.2144	———	
	B	.0001821	.0001909	.0001978	.0002032	———	218
9	A	2.3550	2.3020	———	———	———	
	B	.0001996	.0002097	———	———	———	225
10	A	2.3720	2.3175	———	———	———	
	B	.0002260	.0002379	———	———	———	232
Opt. Slump**		7.3-in.	6.8-in.	6.4-in.	6.0-in.	4.1-in.	

*Excluding particles over 1½-in. diameter.

**Slump for optimum workability, flowability, cohesion, strength, density, and economy, for reinforced and difficult sections.

TABLE 3

Cement Content Factor for Ordinary Control

Cement contents, given by Table 2, must be increased from 16 to 43 per cent, as given herein for the required strengths and slumps, and the corresponding water content determined by the equation,

$$W = 0.01115\ C\ (4.14613 - \log K_s)$$

Strength of Concrete	Per Cent Increase Slump				
	1-in.	3-in.	5-in.	7-in.	9-in.
1,000	16	17	18	19	21
2,000	17	19	21	23	26
3,000	18	21	24	27	32
4,000	20	23	27	32	37
5,000	22	26	31	36	43

Table 2 shows the cement content for the proposed mix to be as follows for skilled control:

$$\log C = (4000 \times .0001630) + 2.1454$$
$$= 2.7974$$
$$C = 627 \text{ lbs.}$$
$$= 3.235 \text{ cu. ft. by absolute volume.}$$

Aggregate Content

The quantity of aggregate is determined by the Feret Law of the Aggregate Content—

$$Av = (Kv/Ky) - (Cv + Wv) \qquad (12a)$$

The absolute volume of aggregate for one cubic yard of the proposed mix is, then—

$$Av = (27/0.980) - (3.235 + 4.264)$$
$$= 20.052 \text{ cu. ft.}$$

Fineness Modulus of Mixed Aggregate

The fineness of grading of the mixed aggregate is determined by the author's Law of the Fineness Modulus—

$$f.m. = D\ (\log C - E) \qquad (13)$$

in which D is a constant for a selected cohesion of mix and E is a constant depending upon the maximum size of the aggregate. E is a minus quantity and varies as the logarithm of the maximum size of the aggregate. For the given criteria, the equation is—

$$f.m. = 1.07\ (\log C - E) \qquad (13a)$$

in which $-E$ is as given in Table 5.

$$E = -2.26607 - \frac{\log A_{ms}}{0.3973}$$

A_{ms} = Maximum (square hole) size of aggregate.

The fineness modulus for the proposed mix is, then—

$$f.m. = 1.07\ (2.7974 + 3.467)$$
$$= 6.70$$

TABLE 4

Approximate Values of Ky in Equations 12 and 12a, Based on the Content of Normal Portland Cement, in Pounds per Cubic Yard of Set Concrete

Pounds of Cement per Cu. Yd. of Concrete	Proportionate Yield of Sum of Absolute Volumes	Pounds of Cement per Cu. Yd. of Concrete	Proportionate Yield of Sum of Absolute Volumes
300	1.019	600	0.981
320	1.015	620	.980
340	1.011	640	.979
360	1.008	660	.978
380	1.005	680	.977
400	1.002	700	.976
420	.999	750	.974
440	.996	800	.972
460	.993	850	.970
480	.991	900	.968
500	.989	950	.967
520	.987	1000	.966
540	.985	1100	.964
560	.983	1200	.962
580	.982	1300	.961

TABLE 5

—E in the Fineness Modulus Equation, f.m. = 1.07 (log C — E), for Various Maximum Sizes of Aggregates

Maximum Size Inches	—*E*	Maximum Size Inches	—*E*
3/16	.4362	2	3.0238
¼	.7446	2½	3.2677
⅜	1.2139	3	3.4670
½	1.5084	3½	3.6355
¾	1.9516	4	3.7815
1	2.2661	4½	3.9002
1¼	2.5100	5	4.0254
1½	2.7093	5½	4.1295
1¾	2.8778	6	4.2247

Grading of Mixed Aggregate

The Abrams development of the fineness modulus provides only for the use of two aggregates, fine and coarse.

Three or more aggregates may be proportioned in an unlimited number of combinations for a given fineness modulus. Therefore, the proportions of three or more aggregates must be determined by an equation of grading. The author's combination of his Law of the Fineness Modulus with Talbot's grading equation provides an algebraic method of determining a grading of any required fineness modulus with any number of aggregates.

The Talbot Grading Equation is—

$$r = 1 - (d/D)^n \qquad (14)$$

in which r is the total proportion by absolute volume retained on or coarser than the given square hole opening of d inches; D is the maximum size of the aggregate; and n is an exponent determining the coarseness of grading.

When $n = 0.5$, the grading is the Fuller parabolic grading curve.

The fineness moduli of gradings for various values of n and D are given in Table 6.

The value of n for the proposed mix, for $D = 3$ in. and $f.m. = 6.70$, is shown by Table 6 to be 0.50. Each of the parts of the grading, represented by the maximum sizes of the six job aggregates, is, likewise, in the $n = 0.50$ grading.

TABLE 6

Fineness Moduli of Gradings for Values of n and D in the Equation $r = 1 - (d/D)^n$

Maximum Size	Fineness Moduli										
	Values of *n*										
D, ins.	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66
6	7.44	7.55	7.67	7.75	7.86	7.94	8.01	8.09	8.17	8.23	8.29
5	7.24	7.33	7.44	7.54	7.61	7.72	7.80	7.86	7.94	8.02	8.07
4½	7.09	7.20	7.30	7.42	7.49	7.57	7.65	7.73	7.80	7.89	7.94
4	6.92	7.04	7.13	7.24	7.33	7.41	7.49	7.55	7.64	7.71	7.79
3½	6.73	6.82	6.94	7.04	7.11	7.21	7.31	7.37	7.44	7.50	7.58
3	6.48	6.59	6.70	6.78	6.88	6.96	7.03	7.11	7.18	7.24	7.30
2½	6.28	6.37	6.47	6.57	6.64	6.74	6.82	6.88	6.96	7.03	7.08
2¼	6.14	6.24	6.34	6.45	6.52	6.59	6.67	6.75	6.82	6.90	6.95
2	5.97	6.08	6.17	6.27	6.36	6.44	6.51	6.57	6.66	6.73	6.80
1¾	5.78	5.87	5.98	6.08	6.14	6.24	6.33	6.39	6.46	6.52	6.59
1½	5.54	5.64	5.74	5.82	5.91	5.99	6.06	6.13	6.20	6.26	6.32
1¼	5.34	5.42	5.52	5.61	5.68	5.77	5.85	5.91	5.98	6.05	6.10
1⅛	5.20	5.30	5.39	5.50	5.56	5.63	5.70	5.78	5.84	5.92	5.97
1	5.04	5.14	5.22	5.32	5.40	5.47	5.54	5.60	5.69	5.75	5.82
⅞	4.85	4.93	5.04	5.13	5.19	5.28	5.37	5.42	5.49	5.55	5.61
¾	4.62	4.71	4.80	4.88	4.96	5.03	5.10	5.17	5.23	5.29	5.35
⅝	4.42	4.50	4.59	4.67	4.74	4.82	4.89	4.95	5.02	5.08	5.13
½	4.13	4.22	4.30	4.39	4.46	4.53	4.59	4.65	4.73	4.79	4.85
⅜	3.73	3.81	3.89	3.96	4.03	4.10	4.16	4.22	4.28	4.34	4.39
¼	3.26	3.34	3.41	3.49	3.55	3.61	3.67	3.72	3.79	3.85	3.90
3/16	2.88	2.95	3.01	3.07	3.14	3.20	3.25	3.30	3.36	3.41	3.46

The fineness moduli of parts of the grading for the proposed mix are shown by Table 6 to be as follows:

Part of Table 6	Job Aggregates	Fineness Moduli
0 to 3 -in.	I to VI, incl.	6.70
0 to 1¾-in.	I to V, "	5.98
0 to 1⅛-in.	I to IV, "	5.39
0 to ⅝-in.	I to III, "	4.59
0 to ¼-in.	I to II, "	3.41

Principle of Simple Proportion

Let p = proportion of fine aggregate.
Then, $1.0 - p$ = proportion of coarse aggregate;
Let F = fineness modulus of fine aggregate;
C = fineness modulus of coarse aggregate;
and M = fineness modulus of mixed aggregate;

$$\text{Then } M = pF + (1 - p)C \qquad (15)$$

$$\text{and } p = (C - M)/(C - F) \qquad (16)$$

Proportioning Three or More Aggregates

Employing Equation 16, the proportions of the theoretical fine, to be combined with the job coarse, to produce the required fineness modulus of the whole, and of the parts, are as follows:

$$\text{Part;} \quad p' \left(\frac{\text{Job Coarse} - \text{Theo. Total}}{\text{Job Coarse} - \text{Theo. Fine}}\right) = p, \text{ Proportion of fine; } 1.0 - p, \text{ coarse} \ldots (16a)$$

$$0\text{-}3'' \quad 1.0 \quad \frac{\overset{(VI)}{8.86} - \overset{(Whole)}{6.70}}{8.86 - \underset{(I\text{-}V)}{5.98}} = 0.75 \text{ of I-V}; \quad 1.0 - .75 = 0.25 \text{ of VI}$$

$$0\text{-}1\tfrac{3}{4}'' \quad 0.75 \quad \frac{\overset{(V)}{8.05} - 5.98}{8.05 - \underset{(I\text{-}IV)}{5.39}} = 0.58 \text{ of I-IV}; \quad 0.75 - .58 = 0.17 \text{ of V}$$

$$0\text{-}1\tfrac{1}{8}'' \quad 0.58 \quad \frac{\overset{(IV)}{7.04} - 5.39}{7.04 - \underset{(I\text{-}III)}{4.59}} = 0.39 \text{ of I-III}; \quad 0.58 - .39 = 0.19 \text{ of IV}$$

$$0\text{-}\ \tfrac{5}{8}'' \quad 0.39 \quad \frac{\overset{(III)}{6.03} - 4.59}{6.03 - \underset{(1\text{-}II)}{3.41}} = 0.21 \text{ of I\&II}; \quad 0.39 - .21 = 0.18 \text{ of III}$$

$$0\text{-}\ \tfrac{1}{4}'' \quad 0.21 \quad \frac{\overset{(II)}{3.92} - 3.41}{3.92 - \underset{(I)}{1.81}} = 0.05 \text{ of I}; \quad 0.21 - .05 = 0.16 \text{ of II}$$

0.05 of I

Total = 1.00

Proportions by Absolute Volume

The proportions by absolute volume for one cubic yard of the proposed mix are as follows:

Materials:			Absolute Vol., Cu. Ft.	
	Cement		3.235	as determined
	Water		4.264	as determined
No. I	Aggregate	0.05 × 20.052 =	1.003	= proportion × abs. vol. of aggregate.
No. II	"	0.16 × 20.052 =	3.208	
No. III	"	0.18 × 20.052 =	3.609	
No. IV	"	0.19 × 20.052 =	3.810	
No. V	"	0.17 × 20.052 =	3.409	
No. VI	"	0.25 × 20.052 =	5.013	
		Total =	27.551	= 27/Yield

Proportions by Moist Weight

The mixing water, plus the absorption of the aggregates, minus the moisture content of the aggregates, determines

(Continued on Page 18)

Produce Exposed Interior Surfaces With Fibre Board Forms

Apply Painted Decorative Work Instead of Plaster on Interior Walls and Ceilings of University Building—Form Details and Make-Up

This is the first of a series of several articles, each complete in itself, on the use of wood-fibre board in concrete form work. This product, originally employed primarily as a lining for wooden forms, is now used as the actual structural material of form work, without other sheathing material.

Other articles in this series will describe form work for other types of buildings, for subway construction, for monolithic concrete sewers, and for concrete bridge construction.—The Editors.

THE recently completed building of Commerce and Finance, for St. Louis University, St. Louis, Missouri, is a modern building in every respect. One of the interesting modern features of this building is its form finished concrete surfaces. Hung ceilings and plaster have been entirely eliminated from its class rooms, corridors and study rooms, as well as other portions of the interior. Painted decorations were applied directly to the exposed concrete surfaces.

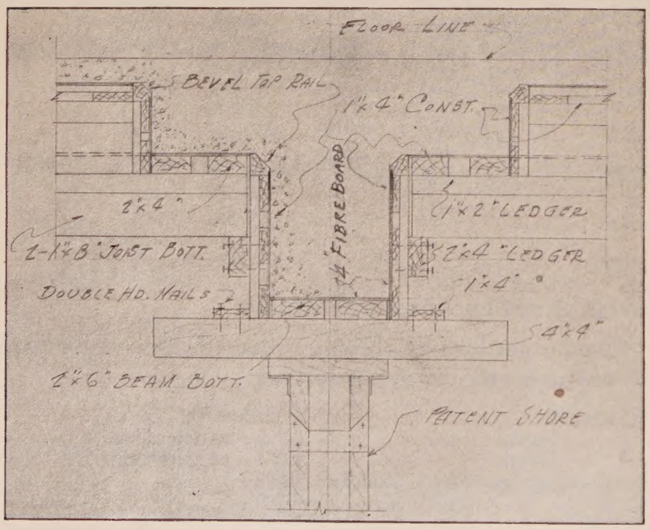


Figure 1. Cross-section of forms for T-beams

In order to obtain this smooth concrete surface on which to apply the decorations, it was decided, after a thorough study of various methods of obtaining this condition, to build the forms with an especially made wood-fibre board manufactured particularly for this purpose.

Form Detailing and Make-Up

Forms for the construction of these exposed concrete surfaces were carefully detailed in the office to fit the construction requirements and the progress schedule of the job. The forms were made in the shop and delivered to the job as needed.

The wood-fibre board previously mentioned is manufactured particularly for concrete form usage. The fibre board used on this construction was ¼ in. thick, delivered to the job in standard size sheets (4 by 12 ft.). This cut-to-size form board was then tacked on to a skeleton wood frame made up to suit various form items as detailed. No ordinary wood sheeting was used.

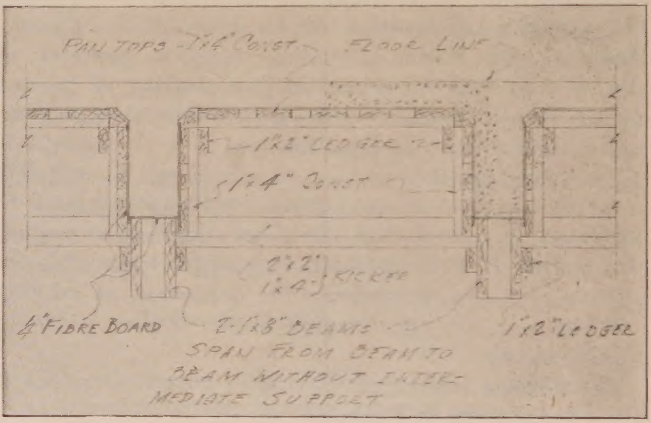


Figure 2. Cross-section of forms for joists

Two board feet of lumber were in general required for each square foot of wood-fibre board. The skeleton frame was constructed of either rough edge lumber or used lumber, depending on what was available, as the frame itself did not come into contact with moisture; nor was it rebuilt. The wood-fibre board forms were stripped, cleaned and made ready to re-use. The combined saving of form lumber and form make-up cost made this a most economical board to use.

Points on Form Construction

Ten and twelve uses of these boards were easily obtained. In compliance with the recommendations of the manufacturer of the fibre board, no form oil was applied to the face of the forms. They were easily stripped without that precaution. The manufacturer's recommendation regarding the omission of form oil is due to the extreme density of the fibre board, as a result of which it does not absorb this oil, and much of it remains on the face of the board. This is likely to cause discoloration of the concrete surface.

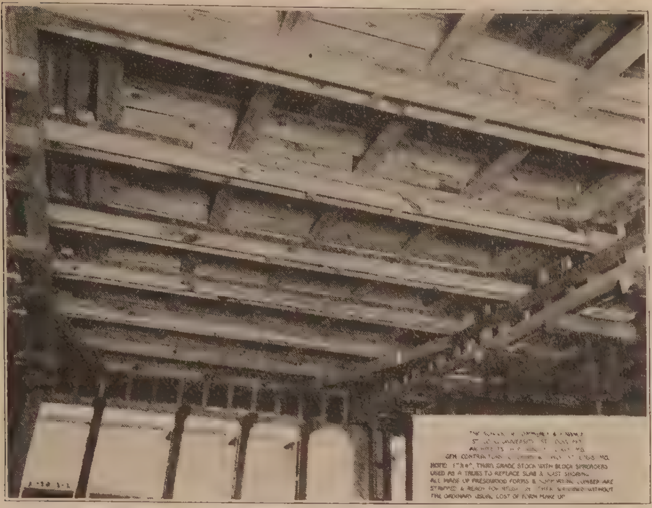


Figure 3. Underneath view of floor form construction

An important detail in constructing the fibre board forms on the St. Louis University contract, especially the beam sides and wall forms where concrete was deposited against the edges of it, was to protect these edges, as shown later in detail (see Figures 1 and 2).

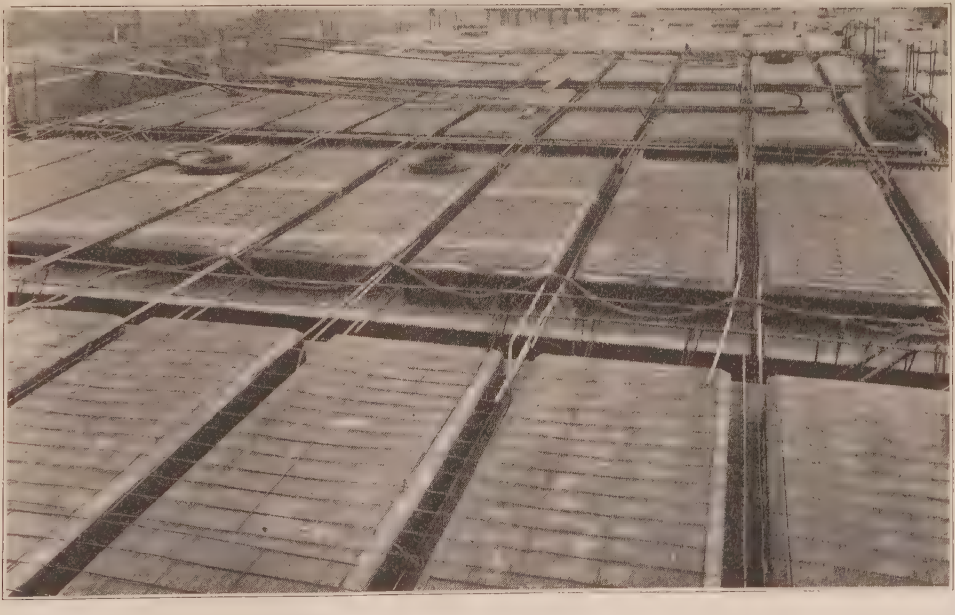


Figure 4. Top view of fibre board floor forms, with steel reinforcement in place

The use of this fibre board in the T-beam type of form construction on the St. Louis building is best told by sketches and photographs, which are self-explanatory.

All Forms Completely Detailed

The university building, for the most part, is the concrete joist type of construction. Generally speaking, the joists are 4 in. wide and 36 in. on center, and from 8 to 12 in. deep. The fact that the required pan widths varied from 28 to 32 in. caused no trouble, since the pan forms were made up in a carpenter shop to detailed sizes and trucked to the job. Complete details were made of all the forms. They were fabricated in the shop and given shop marks and put in place in much the same manner that structural steel is fabricated and erected. Figure 2 is a typical cross-section through two of the T-beams.

Of particular importance in the construction of the beam sides was the beveled top rail shown in Figures 1 and 2. It will be noticed that this top rail was notched so that the edges of the fibre board fitted into it; and in this way these edges were protected from the concrete mass. This detail was well worth the little extra expense it involved in make-up. The T-beam sides were made with 1 by 4's for back-up, and some beams were made with 2 by 2's, as shown by the spandrel beam in Figure 3.

Elimination of Shores

Figure 2 is a typical cross-section through the pan construction. A rather unusual feature of this construction was the use of two 1 by 8-in. timbers as a structural member. Instead of laying a 2 by 8-in. frame, as a joist soffit, and supporting it about every 4 ft. with a shore, these 1 by 8's were used with a 2 by 3-in. core to form a truss which carried slab, joist and T-beams, framing from main beam to main beam, as shown clearly in Figure 3, as well as in the cross-section in Figure 2. This construction eliminates the use of a large number of shores and the cost of erecting and removing them. Figure 3 is an underneath view of typical pans, Figure 4 a top view and Figure 5 a view of some of the joists after they had been stripped but not painted. As a matter of fact, the forms had just been removed and the concrete had little chance to dry out when this photograph was taken.

Conditions for Greatest Economy

For this particular type of construction, it would be well to bear in mind that a multi-story building of at least four stories, one with fairly typical panels throughout, is needed to obtain economical construction costs.

In concrete frame structures, with plain arch and joist floor construction, a much simpler form detail should be used. An article on the use of this fibre board for simpler types of concrete floor construction will be given later in this series.

Description of Fibre Board

Inasmuch as the wood-fibre board is that part of the concrete form that must take the impacts of the concrete mass, resist the abrasion of the concrete aggregates, resist water pressure and produce a smooth finished surface, it might be well to know something of its characteristics.

The board is made from clear wood fibres, closely felted together, without the use of any chemicals or foreign binders. The face is smooth and polished. Its reverse side is minutely corrugated. After the board is manufactured it is specially processed to make it strong, dense and rugged.

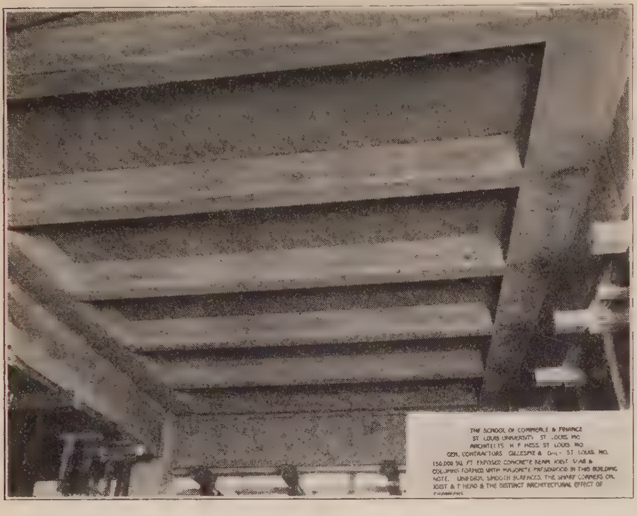

THE SCHOOL OF COMMERCE & FINANCE
ST. LOUIS UNIVERSITY ST. LOUIS MO
ARCHITECTS H. P. HESS ST. LOUIS MO
GEN. CONTRACTORS GILLESPIE & DALY ST. LOUIS MO
150,000 SQ. FT. EXPOSED CONCRETE BEAM JOIST SLAB &
COLUMNS FORMED WITH MASONITE PRESDWOOD IN THIS BUILDING
NOTE. UNIFORM, SMOOTH SURFACES, THE SHARP CORNERS ON
JOIST & T HEAD & THE DISTINCT ARCHITECTURAL EFFECT OF

Figure 5. Underneath view of floor construction after forms were stripped but before decorative painting of joists

The boards are manufactured and delivered in standard size sheets, 4 by 12 ft. The board used in the construction previously discussed was ¼ in. thick. Fibre board is also manufactured in thicknesses of ⅛ in., 3/16 in. and 5/16 in. Each thickness has a particular type of construction for which it is adapted. Further information on these various types of boards will be brought out in future articles.

Weight of Fibre Board

The weights of the fibre board of the various thicknesses are as follows:

Thickness, in.	Weight per 1,000 sq. ft., lb.
⅛	773
3/16	1,093
¼	1,380
5/16	1,620

It can readily be seen that these light fibre boards, together with a minimum amount of dimension lumber in the skeleton frame, will produce a form section that can be handled economically.

This specially processed fibre board has a specific gravity of 1.140, which is greater than the specific gravity of northern hard maple. It has an average tensile strength of 7,000 lb. per sq. in., a working stress of 1,200 lb. per sq. in. and a modulus of rupture of 13,000 lb. per sq. in. Its resistance to abrasion is more than twice that of pine form lumber.

Acknowledgments

The architect of the Building of Commerce and Finance, St. Louis University, is H. P. Hess, of St. Louis. The general contract was held by Gillespie & Daly, of the same city. The sub-contract for the form work was held by the Presdwood Concrete Forms Co., of Chicago, a subsidiary of the Masonite Corporation, manufacturers of the fibre board here described. The area of exposed finish form work on this contract totaled about 150,000 sq. ft.

British Association Wants Wider Roads; To Form Road Research

A conference of road-making and road-using interests is to be called in London with the object of forming a Road Research Committee similar to that which already exists for the development of aeronautics.

Co-Ordinated Laws of Concrete Mixes and Their Application

(Continued from page 15)

the water to be added. The correction is made as follows: $4.264 - 20.052\,[.05(.171 - .050) + .16(.102 - .042) + .18(.053 - .033) + .19(.034 - .024) + .17(.025 - .015) + .25(.020 - .010)] = 4.264 - 20.05\,(0.2589) = 3.745$ cu. ft. of water to be added.

The corresponding proportions by moist weight are:

Material:		Weight, Lb.
	Cement	= 627 as determined
	Added water 3.745 × 62.4	= 234 as corrected
No. I	Agg., 20.052 × 0.05(2.61 + .171) × 62.4	= 174
No. II	" 20.052 × 0.16(2.62 + .102) × 62.4	= 545
No. III	" 20.052 × 0.18(2.63 + .053) × 62.4	= 604
No. IV	" 20.052 × 0.19(2.64 + .034) × 62.4	= 636
No. V	" 20.052 × 0.17(2.65 + .025) × 62.4	= 569
No. VI	" 20.052 × 0.25(2.66 + .020) × 62.4	= 838
	Total	= 4.227

= absolute vol. of aggregate × proportion × $(g + m)$ × 62.4.

Proportions by Loose-Moist Volume

The corresponding proportions by loose-moist bulk volume are:

Material:		Loose-Moist Vol., Cu. Ft.
	Cement 627/94	= 6.7 sacks
	Added Water	= 3.7 cu. ft.
No. I	Agg., 20.052 × 0.05/.511	= 2.0
No. II	" 20.052 × 0.16/.582	= 5.5
No. III	" 20.052 × 0.18/.573	= 6.3
No. IV	" 20.052 × 0.19/.564	= 6.8
No. V	" 20.052 × 0.17/.555	= 6.1
No. VI	" 20.052 × 0.25/.566	= 8.9

= absolute volume of aggregate × proportion divided by *d*.

Proportions by loose-dry, dry-rodded and inundated volume, and by dry weight of aggregates, may be obtained in similar manners.

The foregoing physics and mathematics of proportioning embody all the essentials of calculation of mixtures specified in arbitrary ratio or otherwise. It is particularly adaptable to the various requirements of proportioning at central concrete factories where accuracy and uniformity of yield, strength and consistency are essential.

EDITORIAL

A Distinctive Field for Cast Stone

WHEN cast stone first appeared as an architectural building stone it came in the form of reproductions of various natural stones. Many plants are still producing and marketing this type of product, though in a number of regions these plants have now encountered serious competitive difficulties with natural stone.

Some of the more far-seeing manufacturers of cast stone have acted on the belief that the best solution to the competition with natural stone lies in the use of color and the development of characteristic textures. These manufacturers, within their own communities, have gradually changed the public conception of cast stone. Whereas this product formerly was looked upon as an imitation of natural stone, it is now being considered on its own merits and is winning acceptance as a distinctive form of architectural expression.

By making cast stone in colors and textures that are new and unusual the manufacturer is enabled to offer owners and architects a product which can not be produced economically in natural stone. Moreover, instead of being in the position of fighting for a slice of the existing market that was built up by producers of natural stone, he is building up a new and independent market that the natural product can not reach.

Colorful cast stone provides an excellent selling point in that it satisfies the increasing demands of architects and owners for the unusual. On the other hand, manufacturers must be on guard against the temptation to produce bizarre effects; otherwise there is a real danger that cast stone may suffer incalculable harm from results similar to those produced by the stucco of jazz-age colors and textures of a few years ago.

Color, applied with intelligence, has become a definite architectural requirement, for exterior as well as interior work. The cast stone industry is in a position to supply this requirement over the widest range and at a cost that is not excessive.

Control Equipment for the Small Contract

IT is only natural that the development of equipment for the scientific control of concrete-making has been confined mainly to the requirements of large construction projects. A few visits to small contracts, where anywhere from 50 to 1,000 cubic yards of concrete are being placed, will supply convincing proof of the need for simple proportioning equipment designed for jobs of this size. In too many cases crude methods are still being employed in measuring aggregates, and the quantity of water and the mixing time are left entirely to guess-work.

The more progressive of the smaller contractors are interested in quality control of concrete, and many have devised simple methods for attaining this end. One such instance was described in the September (1931) issue of "Concrete," pages 33 and 34.

Careful study of a series of articles by O. F. Dalstrom, in the February, March and April (1931) issues of "Concrete," will make possible a rather accurate estimate of the control equipment needed by contractors on comparatively small projects. Some accurate means of measuring or weighing the aggregates, definite water control, automatic control of mixing time, and a limited amount of field testing equipment, constitute the greater part of the requirements.

More Winter Highway Work

IN former years highway construction was stopped when cold weather appeared on the horizon. This year state highway departments, both in the North and in the South, are planning to continue some kinds of highway construction work throughout the winter.

Reference has been made in previous issues of "Concrete" to plans inaugurated in Ohio and Illinois for the construction of highway bridges and grade separation structures during the coming winter season. In Michigan plans are being made to carry on an extensive state highway and local road program. Between seven and ten million dollars will be available for the purpose. The work includes 22 bridge projects located in 16 counties. The Michigan Good Roads Association conducted a series of meetings throughout the state to stimulate interest in creating winter work, and indications are that most counties will speed up contract lettings.

Minnesota is taking bids on eight bridges and on monolithic concrete culverts on 65 miles of grading as a step in her program for providing winter work.

Southern states are also going ahead with winter road work. Louisiana is still under full steam and, with 22,000 workmen engaged in road construction, has more men employed on roads than any other state.

Paving can not be done successfully in cold weather with ordinary portland cement because of the prohibitive cost of inclosing and heating the work; but there are numerous other tasks that can be accomplished in winter, such as grading, preparation of drainage structures and bridge building.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Cover Light Concrete and Aggregates in Bureau of Mines Reports

AMONG recent trends in building construction is the rapid introduction of light-weight materials, the efficient use of which permits appreciable savings in total building costs. Furthermore, the heat and sound insulating, fireproofing, and acoustical properties of many of these products are especially good. Since most of these materials are directly related to the mineral industry, a series of reports describing their manufacture, properties, and uses is now being prepared by H. Herbert Hughes, building materials section, United States Bureau of Mines.

The first of these papers is a general summary of the entire field. The rapidly growing importance of home insulation is stressed; the advantages of soundproofing, acoustical treatment, and fireproofing in all types of construction are pointed out; and several examples of unusual architectural treatment of buildings are mentioned. Various light-weight building materials now on the market are discussed briefly.

Succeeding reports will be devoted to a detailed description of an individual material or group of materials. The tentative outline for the series includes burned shale aggregates, cinder concrete, slag concrete, sawdust concrete, aerated concrete, natural volcanic rocks, gypsum products, ceramic products, and mineral wool.

The bureau will welcome suggestions relating to any phase of the study. Communications regarding these reports should be addressed to the United States Bureau of Mines, Washington, D. C.

Highway Research Abstracts

THE Highway Research Board of the National Research Council, Washington, D. C., has started the publication of a valuable series of multigraphed abstracts of reports and papers dealing with highway research, but which have not been extensively published.

Some idea of the value of these abstracts may be gained from the contents of *Research Abstracts No. 2*, October, 1931, in which the following subjects are treated:

(1) Surface Pit Survey on Concrete Pavements. By F. V. Reagel, Missouri State Highway Department.

(2) Development of Method and Apparatus for Flexural Test of Concrete. By V. L. Glover, Illinois Division of Highways.

(3) Jointless Concrete Roads. By J. H. Walker, London, England.

(4) Use of Mortar-Voids Principle in Designing Concrete Mixtures. By V. L. Glover, Illinois Division of Highways.

(5) Use of Paper for Curing Concrete Slabs. By Mark Morris, Iowa State Highway Commission.

(6) Unsoundness of Certain Types of Rock. By Mark Morris, Iowa State Highway Commission.

Authors of unpublished papers are urged to submit them to the Highway Research Board for use in these multigraphs. Copies of the abstracts may be obtained by addressing R. W. Crum, director of the Highway Research Board, 2101 Constitution Avenue, Washington, D. C.

Supplement to Book of A. S. T. M. Standards

THE American Society for Testing Materials has issued the 1931 Supplement to the 1930 Book of A. S. T. M. Standards, as noted on this page in the September issue. The Book of Standards is issued only every third year, and the standards which are adopted by the society in the intervening years are published in supplements, which bring up to date both parts of the Book of Standards, namely Part I, Metals and Part II, Non-Metallic Materials.

The 1931 supplement is a pamphlet of 144 pages, containing 32 standards adopted or revised by the society on September 1, 1931. Seventeen of the standards are new ones, and 15 are replacements of existing standards. The Book of Standards, Parts I and II, together with the 1931 supplement contain all of the 443 standards of the society now in effect. A complete list of these, and the tentative standards as well, is given in the back of the supplement.

Copies of the supplement may be obtained from the American Society for Testing Materials, 1315 Spruce St., Philadelphia.

Highway Builders Study Progress in Concrete Road Construction

RECENT practical developments in the design and construction of concrete highways are being studied by a committee of the American Road Builders' Association. Results of the investigation will be presented at the 29th annual convention and road show in Detroit, January 11-15, 1932. The committee work is in charge of H. F. Clemmer, engineer of tests and materials, District of Columbia, Washington, D. C., as chairman.

Many designs of section, thickness, width, joints, and surface textures are in use. Which of all these designs are giving best service? What has been determined by field surveys?

The designs and the construction conditions said to be largely responsible for quality and life of concrete are thoroughly discussed in the report, which contains definite recommendations and conclusions.

Study Vibrating Tools in Placing Concrete

SUB-COMMITTEE VII of Committee C-9 of the American Society for Testing Materials has inaugurated a study of the use of vibrating tools for placing concrete.

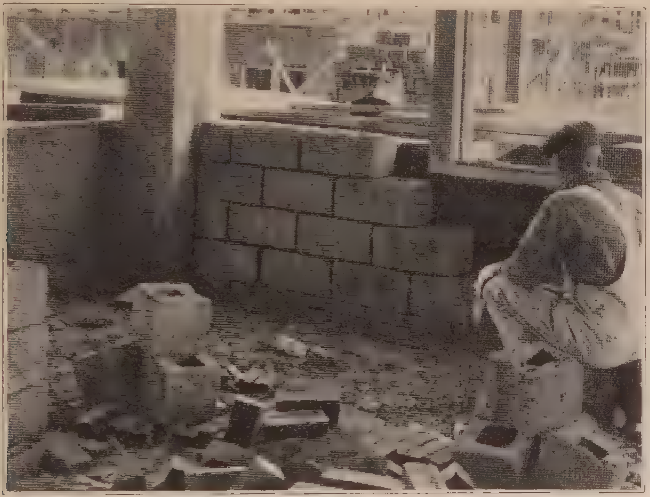
The chairman of Committee C-9 (on Concrete and Concrete Aggregates) is Cloyd M. Chapman, consulting engineer, 105 West 40th Street, New York.

Walls of Welded Concrete Masonry Form Monolithic Construction

Hospital Buildings Comprise Notable Example of Modern Type of Wall Construction—Headers in Face Brick at Every Nineteenth Course

A GROUP of new buildings at Fitkin Memorial Hospital, Asbury Park, N. J., including the main building, a nurses' home and the power house, provide an outstanding example of a modern type of concrete masonry construction known as "weldcrete."

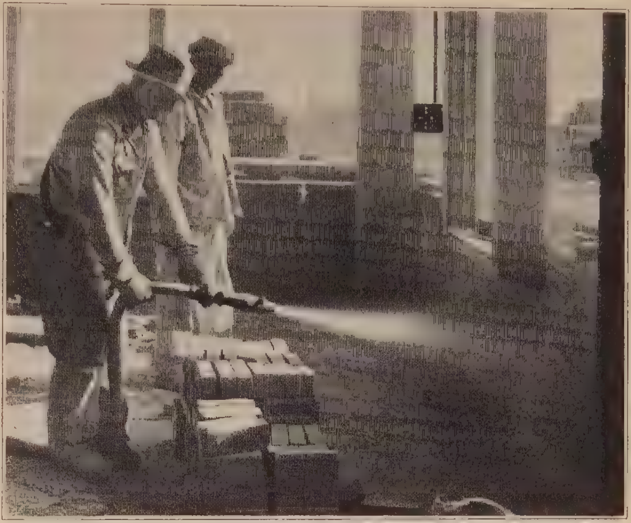
This type of construction, developed several years ago by Earl D. Covell, was described in detail in the September (1930) issue of CONCRETE, pages 27-29. It consists mainly of two coats of gunite, each not less than ½ in. thick, separated by a wall of hollow or solid cinder concrete units. The manner of application of the gunite is such that the joints between the concrete units are filled, the entire wall being "welded" into a monolithic mass.



Cinder concrete back-up units placed dry, the open joints to be filled with gunite

Details of Wall Construction

The three new buildings at Fitkin Memorial Hospital are all of reinforced concrete skeleton frame construction, with floors of the same material. The walls consist of a 4-in. thickness of brick facing, backed by a nominal 8-in. thickness of weldcrete masonry.



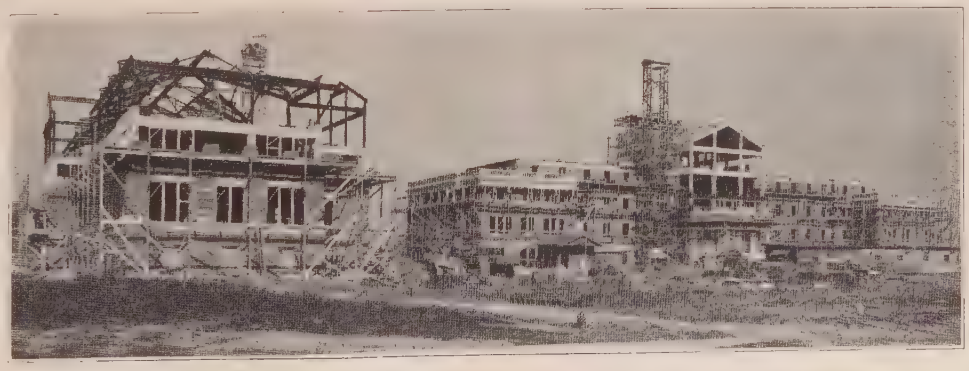
Shooting a ½-in. parge coat of gunite against the face brick

As is customary with this type of construction, the face brick was laid in the usual way, with hand-placed mortar. The back of the face brick was then parged with a ½-in. coat of gunite, this operation being shown in one of the illustrations. The dry cinder concrete back-up units were then laid against the parge coat, the joints between units remaining open because of lugs cast into the units at the time of their manufacture. Following this, gunite was shot against the interior face of the concrete units, until all joints were filled and a ½-in. parge coat was provided as a plaster base. This plaster base coat was then screeded and made ready for the finish coat of hard wall plaster. All the gunite placed was a 1:3 mixture.

▲

Main building and nurses' home at Fitkin Memorial Hospital, Asbury Park, N. J.

▼



Brick Headers Every Nineteenth Course

The reader will readily see that the type of wall construction just described creates a wall that is monolithic in character. This is true throughout the entire wall thickness, the face brick as well as the back-up units.

The monolithic character of the wall construction was given recognition by the architects. The original base specifications required headers at every seventh course in the face brick work. Arrangements were therefore made to build a sample test wall to show that headers in every nineteenth course would be sufficient. Attempts to break the test wall supplied convincing proof that no header courses were needed. It was decided, however, to place headers at every nineteenth course, so as to provide one course of headers midway between floors.

Acknowledgments

The architects were Morris & Erskine, of Philadelphia. The general contractors were the Walter Kidde Constructors, Inc., of New York City, and the general contractors were also the mason contractors. The gunite work was done by Gunite Contractors, Inc., of Allentown, Pa. The cinder concrete units were manufactured by the Fire-Safe Products Co., of Asbury Park, N. J.

The Life of Concrete Pavements

By E. E. DUFFY

RECENTLY the Minnesota state highway department revived an old question when attention was directed to what is probably the first concrete rural road built in that state. The question is: How long will a properly built concrete pavement last?

"This question cannot be answered accurately," reports the highway department, "for no concrete pavement properly built has as yet worn out. That the usual estimates of the life of pavement are too small, and the usual depreciation estimates too large, is indicated by the history of a piece of concrete road just outside of Red Wing, Minn., now 19 years old, and probably the oldest paved road in the state.

"A strip 800 ft. long and 8 ft. wide, on a hill subject to frequent washouts, was paved in 1912. It was built 6 in. thick, without reinforcement. . . . There were no laboratory tests for materials as is the rule today. The aggregates were dumped on the ground, and moved in a wheelbarrow to the mixer, and the wet concrete carried in wheelbarrows to the roadbed."

There are many instances of early rigid type pavements that are still giving good service.

Cutting Corners in Concrete Structural Design

Two Convenient Charts Determine Diameter of Column Core or Number and Size of Bars—Size and Pitch of Spirals

IV—Spiral Columns

By J. R. GOETZ[1]
Structural Engineer, Chicago, Ill.

WHILE there are still a large number of different column formulas in use throughout the country, probably the one most widely used is that of the Joint Code of 1928. That formula is $P = A_c\,[1 + (n - 1)\,p]f_c$ in which $f_c = [300 + (0.10 + 4p)\ f'_c]$. In this formula, f'_c is the minimum ultimate strength of the concrete at the age of 28 days. In the charts here given, this value is 2,000 and 3,000 lb. per sq. in.

Diameter of Column Core

Chart No. 4 gives an easy method of finding both the average unit stress, $P \div A$, or the approximate percentage of vertical steel, p, when the total column load and the diameter of the core are known. Or, if a certain percentage of vertical steel is to be maintained (due to relative costs of concrete and reinforcing steel), the necessary diameter of the column core can then be found from the chart.

For example, suppose that the total column load is 600 kips, and it is desired to use 3 per cent vertical steel. Place a straightedge across the chart, at 600 on the right scale and 3 per cent on the left. The straightedge cuts the middle scale at 27, giving a column core diameter of 27 in.

Chart No. 5 is not new, except that values of 2,000 and 3,000-lb. concrete are given on the same chart, as well as the percentages of vertical steel. Following through with the design of the previous example, by laying the straightedge across the chart with one end on 27 of the right-hand scale and on 3 per cent of the left-hand scale, we read off either 11 bars each $1\frac{1}{4}$ in. square or 14 bars each $1\frac{1}{8}$ in. square for the vertical steel, and $\frac{3}{8}$-in. round spirals with a pitch of $2\frac{1}{8}$ in.

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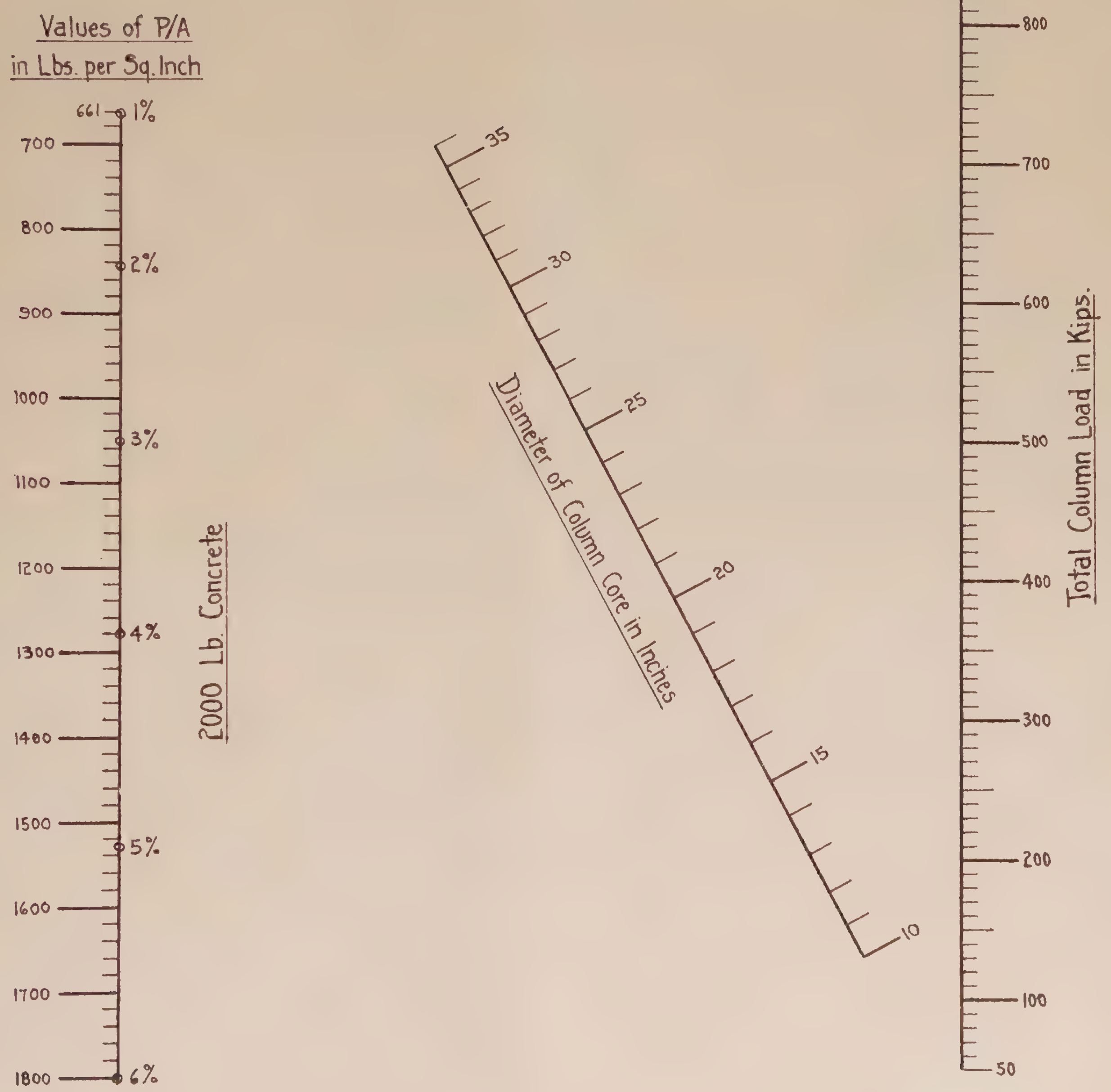
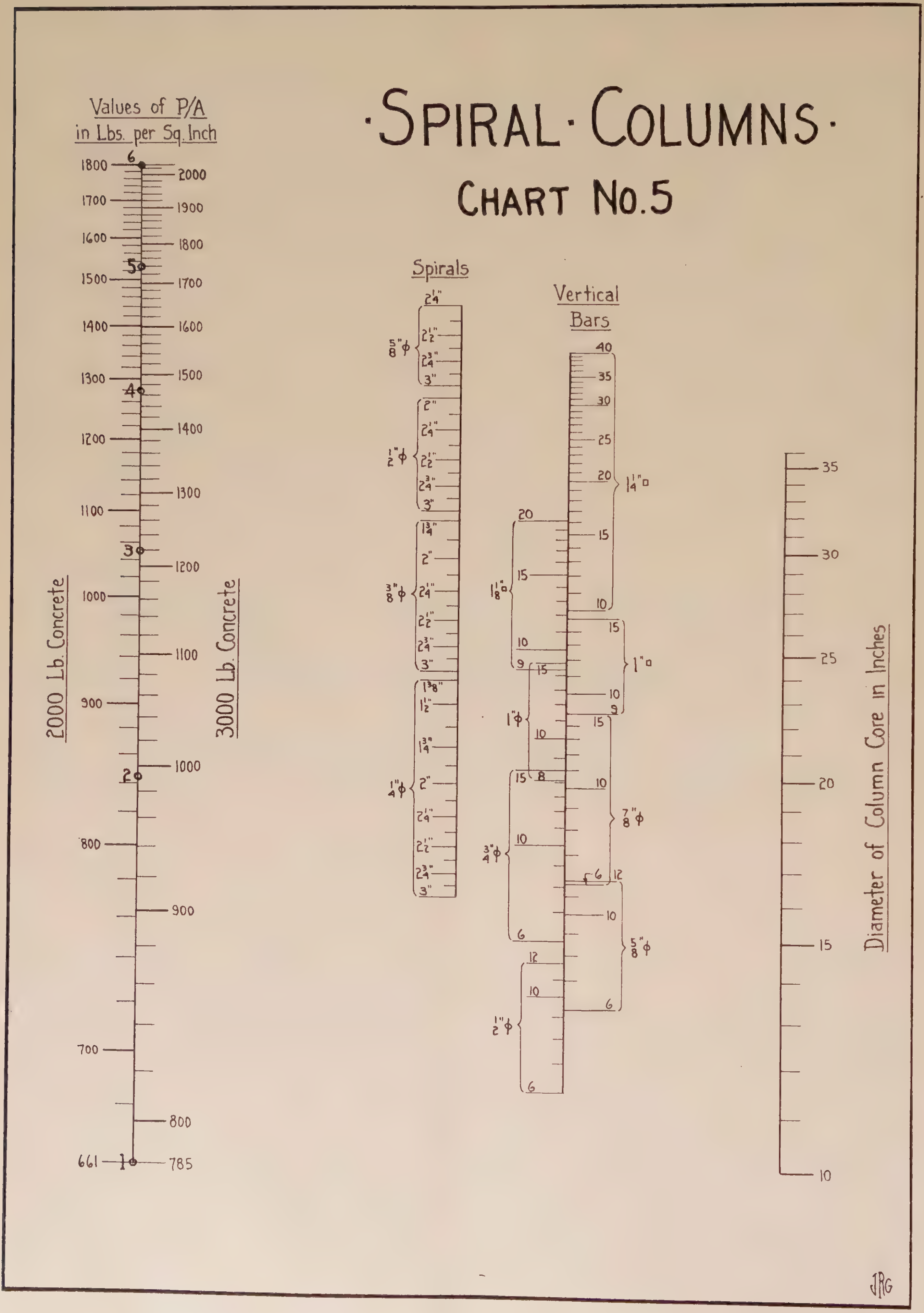
[1] Formerly chief engineer for Ben Marshall, architect, Chicago, Ill.

·SPIRAL · COLUMNS·

CHART NO. 4





·SPIRAL·COLUMNS·

CHART No. 5

Profitable Manufacture of Concrete Building Units

Details of Essential Records of Account of the Selling and Manufacturing Operations—Installation of Numbering System—Typical Entries—Accounting Forms Illustrated

X—Accounting Records

By FRED A. SAGER
Consulting Industrial Engineer

Having covered and solved the problems of the average size products plant from receipt of raw materials to the plant record system, the author of this series brings it to a close with a chapter on the necessary accounting records.

He tells here how to set up the system, the accounts to keep, and carries through to the place where one experienced in handling records can easily continue.—The Editors.

THE accounting records now to be discussed consist of two books—a ledger and a combined cash and journal in which will be entered all essential records of account covering the sales and manufacturing operations of the business. The matter of corporate records will not be covered in this discussion.

Ledger Set-Up

A suggested ledger set-up is shown in Accounting Form 1, so far as the balance sheet and operating accounts are concerned. The ledger will also contain a section of Accounts Receivable, customers' accounts, numbered for reference consecutively, but with the prefix P, as P-15. These two sections of the ledger will follow the numbered accounts shown on Accounting Form 1.

System of Numbering

In Form 1, the "balance sheet" or general ledger accounts, come first in order, the asset accounts with the first digit 1, and liability accounts with the first digit 2. The divisions shown for the assets are, current assets, first digits 11; inventories, first digits 12; fixed assets, first digits 13; and prepaid expenses, first digits, 14. Similar subdivisions are made in the liability accounts.

Such a decimal system of numbering accounts has the advantage of allowing any number of sub-accounts to be inserted, without renumbering or disturbing the numbers previously assigned to the accounts, as is illustrated in

LIST OF LEDGER ACCOUNTS+

General Ledger Accounts

Assets

Current Assets
111 Cash
112 Accounts Receivable
113 Notes receivable

Inventories
121 Cement
122 Cinders
123 Reinforcing Rods
124 Fuel
125 Finished Product

Fixed Assets
131 Building
132 Tools & Equipment
133 Furniture & Fixtures
134 Organization Expense

Prepaid Expenses
141 Fire Insurance p.p.
142 Liability Insurance p.p.
143 Construction Reports p.p.
144Printed matter(adv)
145 Auto Expense p.p.

Liabilities

Current Liabilities
211 Accounts Payable
212 Notes Payable

Accrued Expenses
2131 · Payroll
2132 Water Accrued
2133 Taxes Accrued

Depreciation Reserve
221 Building Depreciation
222 Equipment Depreciation

Capital Stock
231 Preferred Stock
232 Common Stock

Surplus
241 Surplus

Operating Accounts

Income Accounts
31 Sales Profit and Loss
32 Sales of Blocks
33 Discounts Earned
34 Interest Earned
35 Miscellaneous Income

Expense Accounts

Manufacture
410 Manufacture

4111 Rent
4112 Fuel
4113 Water
4114 Electric Light & Power
4115 Telephone
4116 Tool & Plant Repair
4117 Machinery Repair
4118 Fire Insurance
4119 Liability Insurance
4120 Taxes
4121 Sundry Plant Expense
4130 Depreciation

Delivery Expense
421 Haulage of Blocks
422 Freight on Blocks

Sales Expense
431 Sales Commissions
432 Auto Expense
433 Advertising Used
434 Construction Reports Service Used
435 Discounts on Sales
436 Telephone

Administrative Expense
441 Office Salaries
442 Office Supplies

General Expenses
451 Legal & Corporate Fees
452 Interest
453 Misc. General Expense
454 Tests

Dividends
511 Dividends

Accounting Form 1

the case of manufacturing expense accounts, under the general numerical heading of the first two digits 41, where detail accounts run from 4111 to 4121, with an additional account 4130.

Operating Accounts

The operating accounts include income accounts, first digit 3, and the expense accounts, first digit 4, suggested accounts being shown under usual division headings in general. Attention may be called, however, to income account 31, Sales Profit and Loss, which is inserted as a clearing account, in which the amount received for the block sold "at the plant," that is, after deducting the expense of delivery, and the discounts allowed, is set up alongside the sales expense. Attention is also called to the account Manufacture 410, which is another clearing account for all items of manufacture.

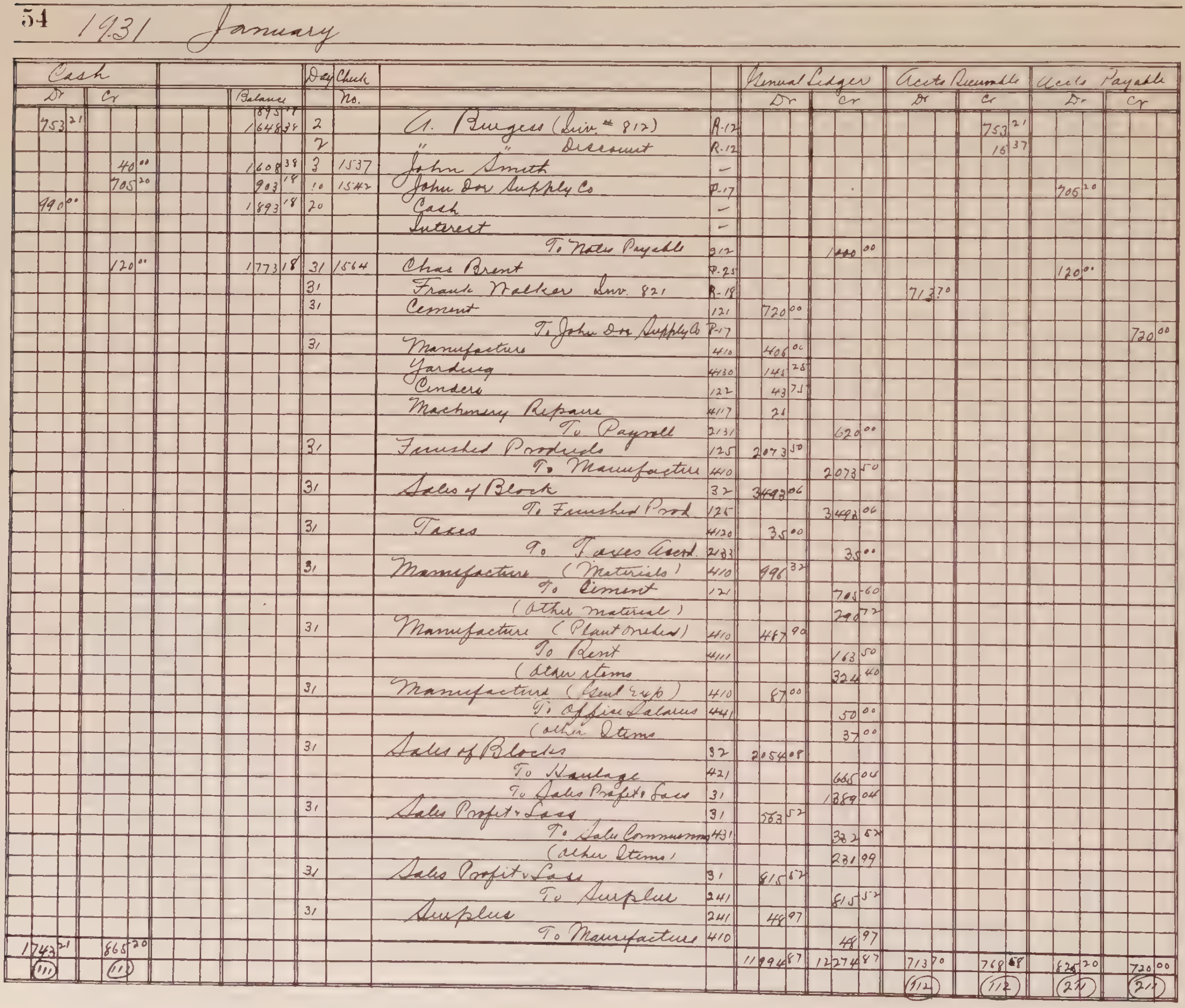
The result of the use of these accounts, taken together with other accounts as shown, is that the journal entries directly provide the figures desired at the end of the month to exhibit the state of the business. This is done as far as manufacturing and sales cost are concerned, as shown in Accounting Forms 4 and 5.

The combined cash and journal is shown in Accounting Form 2 as a 26-column journal, 4 to the left and 22 to the right. The columns to the left will be used for cash. To the right are found, first, General Ledger entries, next Accounts Receivable, and Accounts Payable, followed in turn by Sales and Discounts. A total of ten columns to the right is thus used, with provision for both debit and credit entries. Next follow any expense accounts that may have frequent entries during the month, but that need only to be posted as a total amount for the month in the ledger, such as Payroll paid and Interest paid.

Unused columns at the extreme right will usually occur, which gives ample space for explanatory notes regarding the entries, to the end that this cash and journal record contains all necessary and desirable information. As shown in Accounting Form 2, these entries are often a reference to the source of the entry. This can be expanded, if desired, to a specific reference, as in case of the fifth explanatory note regarding the entry of Jan. 31, reading "Bill of 1/31 for Jan. Cement," which may include "1200 sax @ 60c."

Cash and Journal Entries

Accounting Form 2 is set up to include one entry of



54 1931 January

Cash				Day	Check			General Ledger		Accts Receivable		Accts Payable	
Dr	Cr		Balance		No.			Dr	Cr	Dr	Cr	Dr	Cr
			895.17										
753.21			1648.38	2		A. Burgess (Inv. # 812)	R-12				753.21		
				2		" " Discount	R-12				15.37		
	40.00		1608.38	3	1537	John Smith	—						
	705.20		903.18	10	1542	John Doe Supply Co	P-17					705.20	
990.00			1893.18	20		Cash	—						
						Interest	—						
						To Notes Payable	212		1000.00				
	120.00		1773.18	31	1564	Chas Brent	P-25					120.00	
				31		Frank Walker Inv. 821	R-18			713.70			
				31		Cement	121	720.00					
						To John Doe Supply Co	P-17						720.00
				31		Manufacture	410	406.00					
						Yarding	4130	145.25					
						Cinders	122	43.75					
						Machinery Repairs	4117	25					
						To Payroll	2131		620.00				
				31		Finished Products	125	2073.50					
						To Manufacture	410		2073.50				
				31		Sales of Block	32	3493.06					
						To Finished Prod.	125		3493.06				
				31		Taxes	4120	35.00					
						To Taxes Accd.	2133		35.00				
				31		Manufacture (Materials)	410	996.32					
						To Cement	121		705.60				
						(Other material)			290.72				
				31		Manufacture (Plant Overhead)	410	487.90					
						To Rent	4111		163.50				
						(Other items			324.40				
				31		Manufacture (Genl Exp)	410	87.00					
						To Office Salaries	441		50.00				
						(other Items			37.00				
				31		Sales of Blocks	32	2054.08					
						To Haulage	421		665.04				
						To Sales Profit & Loss	31		1389.04				
				31		Sales Profit & Loss	31	563.52					
						To Sales Commissions	431		332.52				
						(other Items)			231.99				
				31		Sales Profit & Loss	31	815.52					
						To Surplus	241		815.52				
				31		Surplus	241	48.97					
						To Manufacture	410		48.97				
1743.21	865.20							11994.87	12274.87	713.70	768.58	825.20	720.00
(111)	(111)									(112)	(112)	(211)	(211)

Accounting

each kind that will ordinarily occur in the month's business. As this form serves as Cash Book, the cash balance from Dec. 31 is set up in the column to the left as $895.17. The first entry is the receipt of a check for $753.21 for a previous invoice No. 812 in amount $768.58, on which a discount of $15.37 was taken, as indicated by the second entry, which credits Burgess with a total of $768.58 and debits Cash and Discounts with their proper amounts.

The third entry, of Jan. 3, is one of the five payroll checks written this date and credits Cash and debits Payroll. As these items will not be posted separately to the ledger, the reference column is checked and no ledger reference shown.

At the end of the month, the total of Payroll debits is posted to the ledger as indicated by the posting reference, 2131, shown at the foot of the column.

Cement Entry

The entry of Jan. 10 credits Cash and debits Accounts Payable, recording payment to John Doe Supply Co. for the bill for cement received in December. The entry of Jan. 20 shows the proper debits and credits on account of a 60-day note given the bank. That of Jan. 31 is the payment of office salary for January.

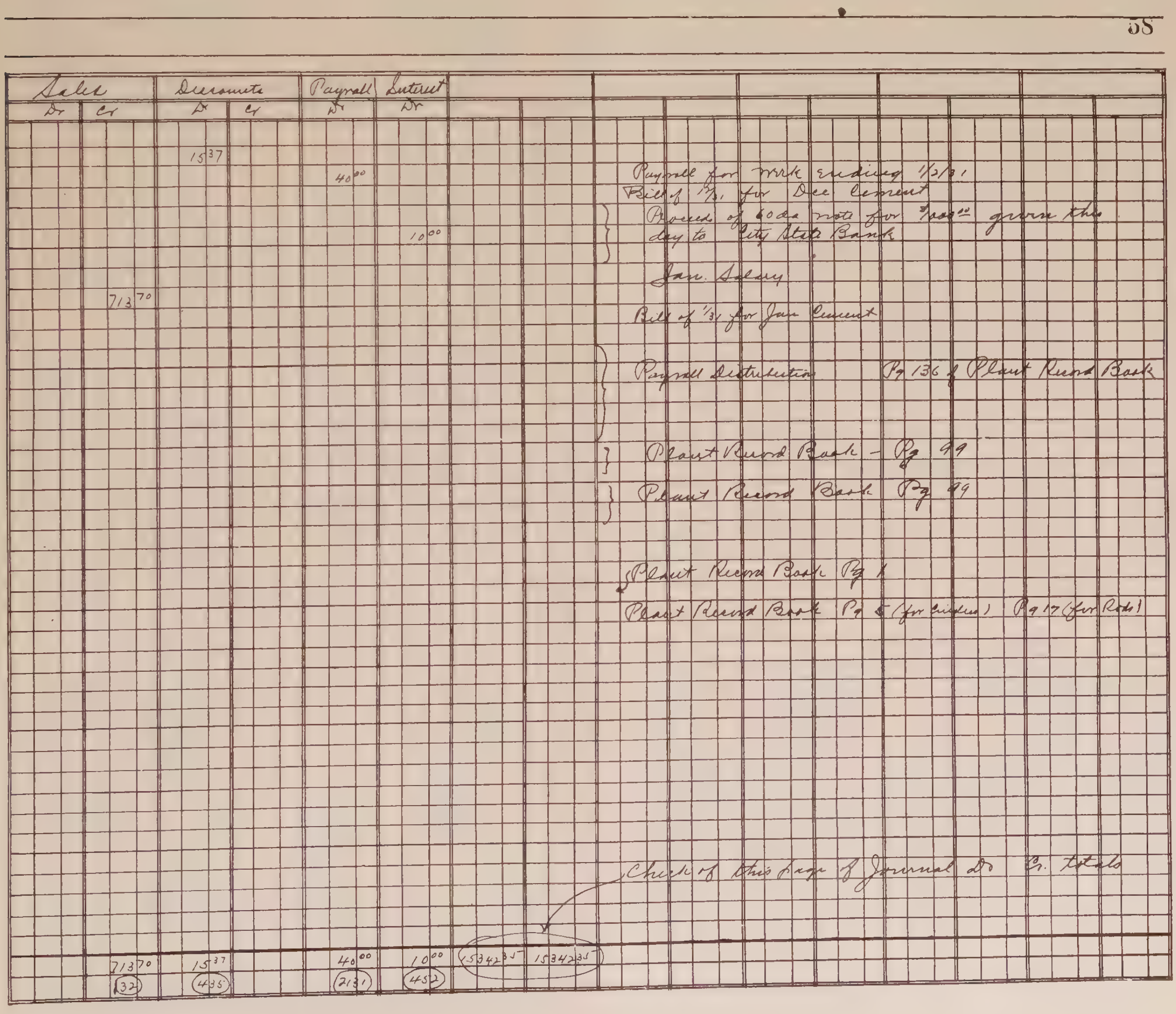
Typical Month's Records

These entries, covering eight lines in Accounting Form 2, are typical of the entries made during the 31 days of the month, and of course, contain all of the Cash entries that will appear in the month's records. As to the Cash record, the balances carried in the column to the left show the amount on hand at all times.

The check number, shown in its column, serves as a Voucher Record. These numbers should be consecutive and if a check is voided for any reason, the number should be entered in this column with appropriate explanation, one check on the accuracy of the record being the consecutive numbering in this record. It should be understood that in the actual month's record, the entries illustrated in eight lines will occupy from one to four pages of the form, and all these entries will have been made by the last day of the month.

The entries following, all dated the 31st, can not be made until bills are received from dealers or those rendering services to the company, which in general may be three or four days for current bills.

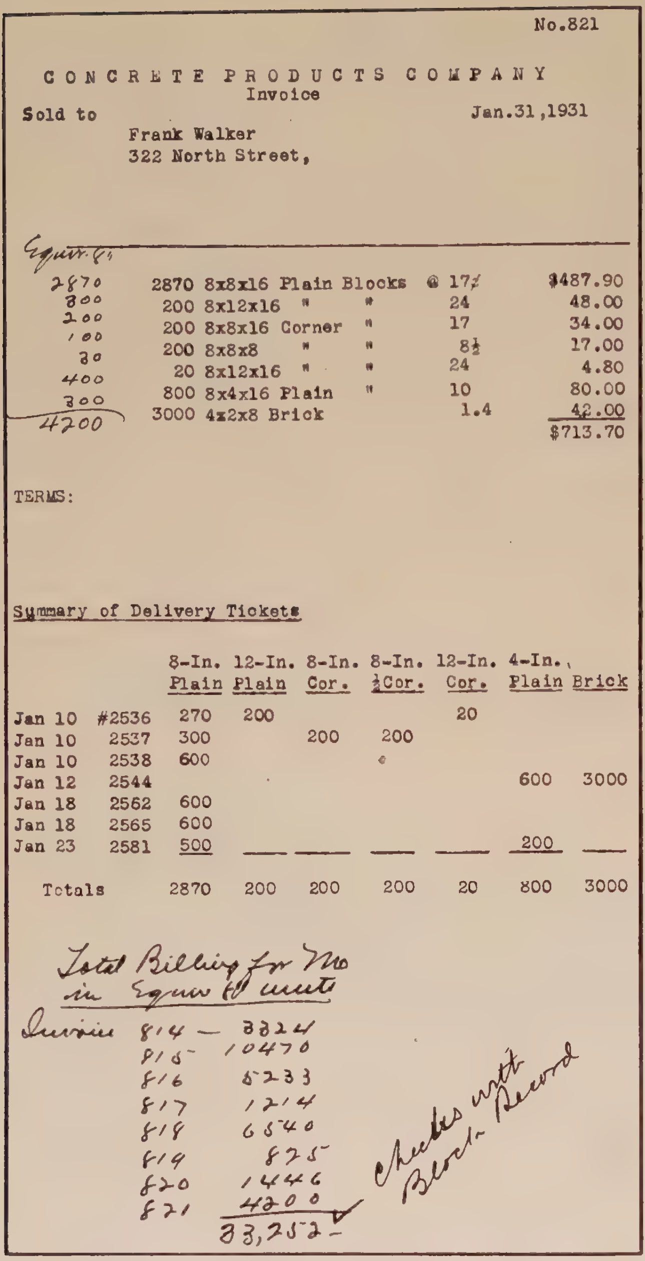
In the meantime, however, or as soon as cash transactions occur, the Cash and Journal for the following month must be opened, which can be done by reserving enough



58

Sales		Discounts		Payroll	Interest			
Dr	Cr	Dr	Cr	Dr	Dr			
		15 37						
				40 00				Payroll for work ending 1/3/31
								Bill of 12/31 for Dec Cement
								Proceeds of 60 da note for $1000 given this
					10 00			day to City State Bank
								Jan. Salary
	713 70							
								Bill of 1/31 for Jan Cement
								Payroll Distribution Pg 136 of Plant Record Book
								Plant Record Book - Pg 99
								Plant Record Book Pg 99
								Plant Record Book Pg 1
								Plant Record Book Pg 5 (for cinders) Pg 17 (for Rods)
								Check of this page of Journal Dr Cr totals
	713 70	15 37		40 00	10 00	15342 35	15342 35	
	(32)	(435)		(2131)	(452)			

Form 2



No.821

CONCRETE PRODUCTS COMPANY
Invoice

Sold to Jan.31,1931

Frank Walker
322 North Street,

Equiv. 8's				
2870	2870 8x8x16 Plain Blocks	@ 17¢	$487.90
300	200 8x12x16 " "	24	48.00
200	200 8x8x16 Corner "	17	34.00
100	200 8x8x8 " "	8½	17.00
30	20 8x12x16 " "	24	4.80
400	800 8x4x16 Plain "	10	80.00
300	3000 4x2x8 Brick	1.4	42.00
4200			$713.70

TERMS:

Summary of Delivery Tickets

		8-In. Plain	12-In. Plain	8-In. Cor.	8-In. ½Cor.	12-In. Cor.	4-In. Plain	Brick
Jan 10	#2536	270	200			20		
Jan 10	2537	300		200	200			
Jan 10	2538	600						
Jan 12	2544						600	3000
Jan 18	2562	600						
Jan 18	2565	600						
Jan 23	2581	500					200	
Totals		2870	200	200	200	20	800	3000

Total Billing for Mo
in Equiv 8 units

Invoice	814 —	3324
	815	10470
	816	5233
	817	1214
	818	6540
	819	875
	820	1446
	821	4200 ✓
		33,252 –

Checks with Block Record

Accounting Form 3

space for the dealers' bills and for closing entries, the invoices for blocks sold being entered at once, the space for them being known.

Sales Procedure and Entry

The first of these entries at the end of the month shows Frank Walker charged with $713.70 for Invoice 821 and Sales credited with a like amount. These entries originate with the invoices shown as Accounting Form 3. These invoices are based on the delivery tickets and the following procedure is suggested: When an order is received and shipment and delivery is about to be made, make a form like the lower part of Invoice No. 821, and enter, above the columns headed "8-In. Plain," "12-In. Plain," etc., the number of each kind of unit covered by the order.

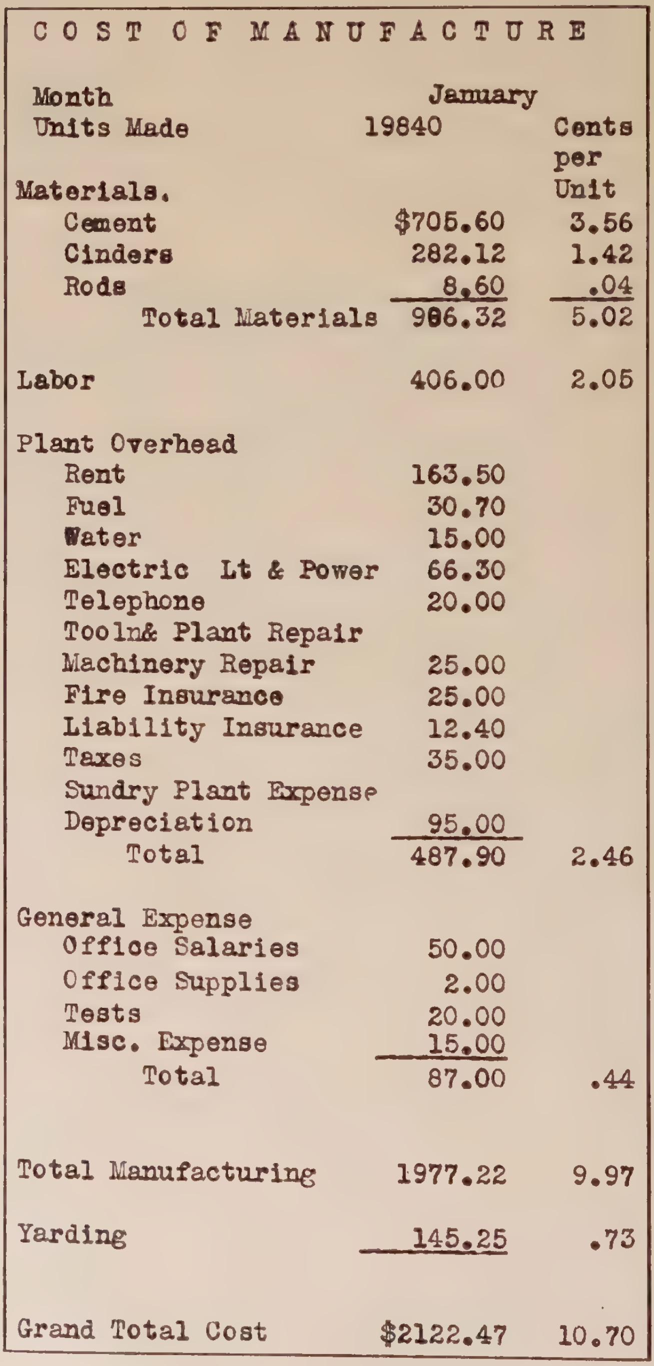
Each day as deliveries are made the entries should be made on these forms, which serve two purposes; first, to keep advised as to progress on each customer's order or requirements, and second, for the purpose of billing at the end of the deliveries, or end of the month, as may be desired.

At the billing time all that is required is to collect the totals appearing at the bottom of the columns, and apply unit prices to them as at the top of Invoice 821, Form 3. This procedure permits of getting most invoices in the mail on the last day of the month, and all mailed not later than the first of the following month.

The remainder of these accounting records will readily be followed through by any accountant who is sufficiently experienced to keep records of this character.

Study of Expenses

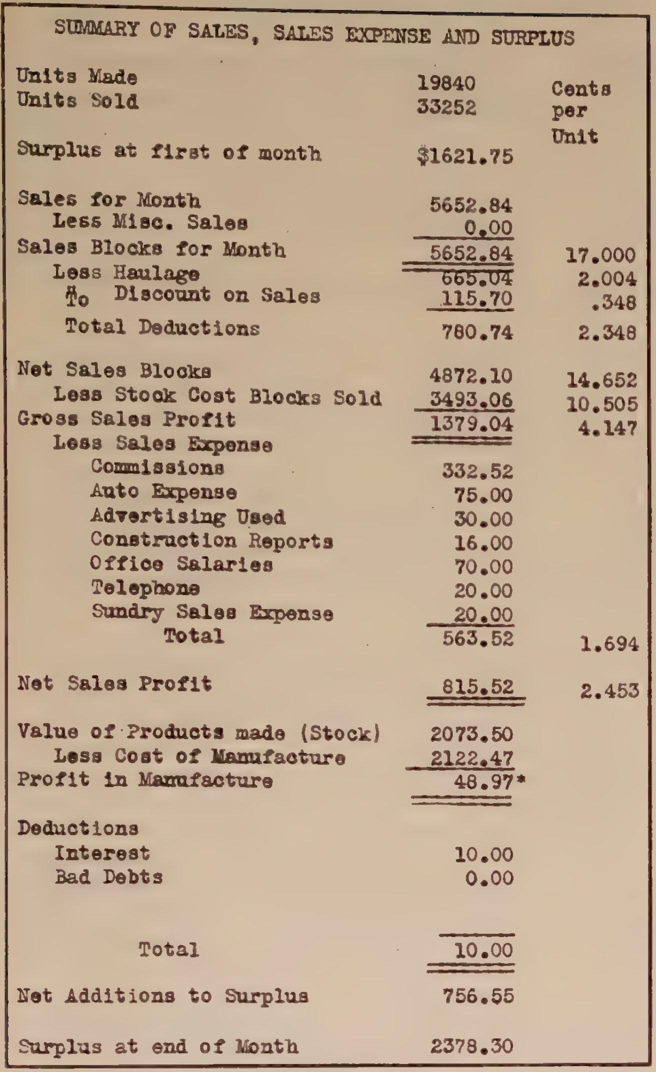
Study and analysis should be made of all items of expense, both manufacturing and sales, to the end that every possible corner may be turned in cost reduction. Such



COST OF MANUFACTURE

Month	January	
Units Made	19840	Cents per Unit
Materials.		
Cement	$705.60	3.56
Cinders	282.12	1.42
Rods	8.60	.04
Total Materials	996.32	5.02
Labor	406.00	2.05
Plant Overhead		
Rent	163.50	
Fuel	30.70	
Water	15.00	
Electric Lt & Power	66.30	
Telephone	20.00	
Tool& Plant Repair		
Machinery Repair	25.00	
Fire Insurance	25.00	
Liability Insurance	12.40	
Taxes	35.00	
Sundry Plant Expense		
Depreciation	95.00	
Total	487.90	2.46
General Expense		
Office Salaries	50.00	
Office Supplies	2.00	
Tests	20.00	
Misc. Expense	15.00	
Total	87.00	.44
Total Manufacturing	1977.22	9.97
Yarding	145.25	.73
Grand Total Cost	$2122.47	10.70

Accounting Form 4



SUMMARY OF SALES, SALES EXPENSE AND SURPLUS

		Cents per Unit
Units Made	19840	
Units Sold	33252	
Surplus at first of month	$1621.75	
Sales for Month	5652.84	
Less Misc. Sales	0.00	
Sales Blocks for Month	5652.84	17.000
Less Haulage	665.04	2.004
% Discount on Sales	115.70	.348
Total Deductions	780.74	2.348
Net Sales Blocks	4872.10	14.652
Less Stock Cost Blocks Sold	3493.06	10.505
Gross Sales Profit	1379.04	4.147
Less Sales Expense		
Commissions	332.52	
Auto Expense	75.00	
Advertising Used	30.00	
Construction Reports	16.00	
Office Salaries	70.00	
Telephone	20.00	
Sundry Sales Expense	20.00	
Total	563.52	1.694
Net Sales Profit	815.52	2.453
Value of Products made (Stock)	2073.50	
Less Cost of Manufacture	2122.47	
Profit in Manufacture	48.97*	
Deductions		
Interest	10.00	
Bad Debts	0.00	
Total	10.00	
Net Additions to Surplus	756.55	
Surplus at end of Month	2378.30	

Accounting Form 5

study should be made before the plant site is chosen, to the end that the least cost of transportation, considering both raw materials and the delivery of the finished product, may be secured.

After operation begins these statements should be studied monthly to see that all costs are held in line, and greater economies effected where possible.

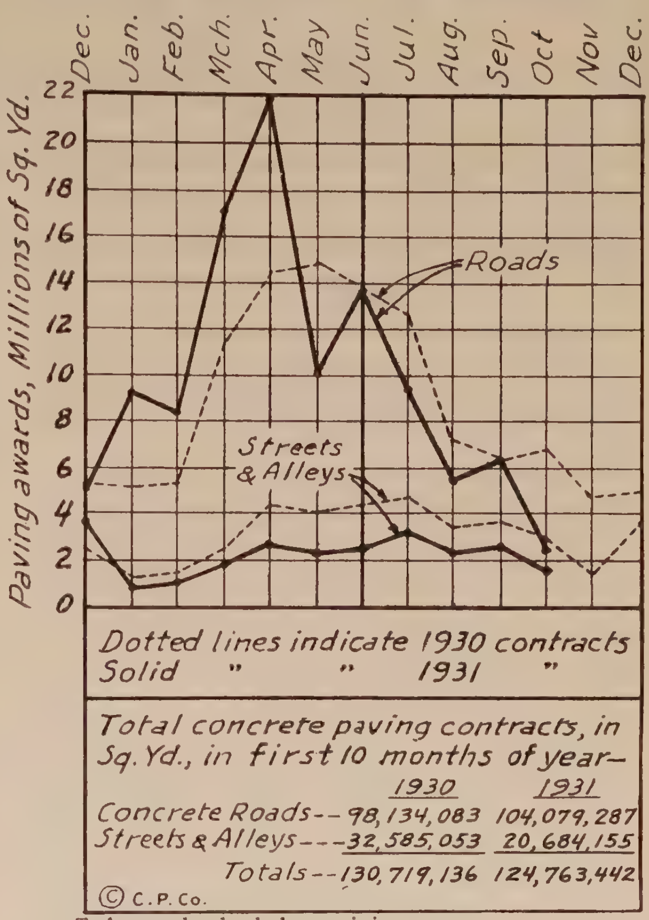
Concrete Paving Six Million Yards Below Last Year

Contracts for Concrete Roads Well Ahead of 1930—To Build Highway Structures This Winter

Contracts for concrete roads awarded during the first 10 months of 1931 are still leading the corresponding period of 1930 by about 6 million square yards; but with street and alley paving contracts dropping 12 million square yards below 1930, total concrete paving awards are about 6 million square yards below last year.

The month of October experienced a considerable drop in concrete road awards. This poor showing is due in part to the inability to let contracts in Illinois under the provisions of the minimum-wage law. The state supreme court declared the law unconstitutional on October 19, but the decision came too late to permit extensive awarding of contracts this year.

The highway departments of Ohio, Illinois and other states have announced extensive construction programs for the coming winter, particularly affecting structures such as bridges and grade separation structures, where the work can be completely inclosed during cold weather.



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~ PERSONALS ~

A. W. King has resigned as service manager for the Cowham Engineering Co., at Chicago, Ill., necessitated by a reduction in personnel following receivership of the Consolidated Cement Corp., the largest cement company operated by the Cowham System.

Mr. King joined the Cowham System May 16, 1929. Previously he was associated for two years with the structural and technical bureau of the Portland Cement Association, and for ten years he was in charge of the Materials Testing Laboratory of the Bureau of Science, Manila, Philippine Islands. In addition he was sales engineer for the Kalman Floor Co. and was engaged in technical research and promotive work for the Atlas Lumnite Cement Co.

Thomas J. Harte has been elected vice-president and general sales manager of the North American Cement Corp., Albany, N. Y. He succeeds the late Frederick A. Boeye.

HOW TO DO IT

◆ **Questions and Answers** ◆
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Prevention and Removal of Oil Stains on Concrete Floors

I am trying to get some information on how to prevent the staining of a concrete floor which is to be used where gasoline, lubricating oils and greases are handled. What can you supply me on this subject?—D. O. L., Chicago, Ill.

The construction problem involved in preventing such stains is that of making the surface of the floor so hard and dense that it will not absorb oil. The surest means of attaining that result is to follow the specifications adopted by the American Concrete Institute, and then adding to the assurance by applying a commercial floor hardener to the surface. Competent inspectors should be employed to insure that the specified procedure is followed in the construction of the floor.

The American Concrete Institute floor specifications are printed in full on pages 37-38 of the August (1930) issue of CONCRETE, while the procedure from which the specifications were developed will be found in the prior issues of May, 1930, pages 33-34, and June, 1930, pages 31-33. All this material appears in publications of the American Concrete Institute.

For cases where an existing concrete floor is to be cleaned of oil stains, the method described on page 52 of the June (1930) issue of CONCRETE is recommended. The procedure there described consists of first wiping off the surface of the concrete; or, it may be scrubbed quite clean, first using kerosene or gasoline to cut the oily deposit. Vigorous scrubbing with a stiff brush removes most of this oil. The surface is then thoroughly flushed with a hose stream of clean water and kept wet for about ten minutes. While the surface is still moist, dry portland cement is dusted over it with an ordinary flour sifter. The whole surface is then swept with a fine broom. On drying, the surface coat of cement becomes light gray, and it covers up stains which can not be cleaned off completely.

Question of Hardening of Frozen Concrete

Is it a fact that concrete, when frozen, will thaw out and continue to harden in a normal manner?—N. C. O., Buffalo, N. Y.

Concrete that has been frozen before the hardening process was completed will thaw out and continue the hardening action, provided it is protected and kept from further freezing. When fresh concrete has been frozen even once it will never attain its full strength. If it is allowed to freeze and thaw several times it is likely to become disrupted and will then have little value.

When concrete has been frozen it must be covered or inclosed, and kept warm and moist until it has thawed out and the hardening has been completed. The temperature surrounding such concrete should be kept well above 55 deg. F. It should be sprinkled or otherwise moistened at least twice daily, to prevent premature drying out.

The fact that freezing will damage fresh concrete, however, should not discourage concrete construction in winter. Success in placing concrete in cold weather is simply a matter of heating the water, or the water and fine aggregate, keeping the work covered or inclosed, and keeping the inclosure warm until the hardening process is completed.

Durability and Practicability of Concrete Burial Vaults

The question of the durability of concrete burial vaults has come to my attention. I shall appreciate it if you will inform me where information can be obtained regarding them.

I am inclined to have doubts as to the practicability of the use of concrete for this purpose, since with the thin section exposed to ground moisture there is danger of the rusting of the wire mesh used as reinforcement.—D. C. E., Bethlehem, Penna.

The long period of years since concrete was first used in the manufacture of burial vaults, and the increasing use of vaults of this material, probably supply the best evidence of satisfactory performance. As a check-up, reliable information can be obtained through personal calls on the superintendents of large city cemeteries where concrete vaults have been used extensively.

We have not heard of the development of any trouble of the kind you suggest. The manufacturers of concrete burial vaults seem to have foreseen the necessity of avoiding carelessness in manufacturing methods. They have a well organized national association (National Concrete Burial Vault Association, J. H. Stuart, secretary, Bremen, Ohio), and through this association they have disseminated a knowledge of good manufacturing practice.

The problem of density, of course, is best solved by the use of electrically-driven or compressed air-driven vibrators. Many plants use such vibrators, though some continue to depend on vibration by jolting or hammering.

Most plants give special attention to the proportioning of aggregates, and ordinarily the ½-in. size is the largest aggregate employed.

With careful proportioning of materials and the use of some effective method of vibration, rusting of steel reinforcement is extremely improbable. The very fact that the vault is in an underground position, where it is little affected by temperature changes and variations in moisture, tends to prevent the concrete from cracking. Since steel can not rust except in the presence of both air and moisture, and since air can not reach the steel except through cracks, the danger of rusting is quite negligible. Even this remote danger may be further removed by the use of galvanized steel reinforcement.

Organizations

American Association of State Highway Officials; W. C. Markham, Executive Secretary, 1222-24 National Press Building, Washington, D. C.

American Concrete Institute; Harvey Whipple, Secretary, 641 New Center Building, Detroit, Mich.
Twenty-eighth annual convention, March 1-4, Wardman Park Hotel, Washington, D. C.

American Concrete Pipe Association; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

American Road Builders' Association; Chas. Upham, Engineer-Director, National Press Building, Washington, D. C.
Twenty-ninth annual convention and road show, January 9-15, Municipal Airport building, Detroit, Mich.

American Society of Civil Engineers; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

American Society for Testing Materials; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.

American Standards Association; P. G. Agnew, Secretary, 29 West 39th St., New York City.

Associated General Contractors of America; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

Building Officials Conference of America; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

Canadian Engineering Standards Association; 46 Elgin St., Ottawa, Ontario.

Cast Stone Institute; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.

Cement Institute; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

Concrete Masonry Association; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

Concrete Reinforcing Steel Institute; M. A. Beeman, Secretary, Tribune Tower, Chicago.

Engineering Institute of Canada; 2050 Mansfield St., Montreal, Quebec.

Highway Research Board; R. W. Crum, Engineer-Director, B and 21st Sts., Washington, D. C.
Eleventh annual meeting, December 10-11, National Academy of Sciences, Washington, D. C.

Joint Committee on Standard Specifications for Concrete and Reinforced Concrete; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

National Board of Fire Underwriters; W. E. Mallalieu, General Manager, 85 John St., New York City.

National Concrete Burial Vault Association; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.

National Crushed Stone Association; J. R. Boyd, Secretary, 1735 14th Street, N. W., Washington, D. C.
Fifteenth annual convention, January 19-22, William Penn Hotel, Pittsburgh, Pa.

National Engineering Inspection Association; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

National Fire Protection Association; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.

National Lime Association; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.

National Ready-Mixed Concrete Association; V. P. Ahearn, Secretary, 545 Munsey Building, Washington, D. C.
Second annual convention, January 25-26, William Penn Hotel, Pittsburgh, Pa.

National Sand and Gravel Association; V. P. Ahearn, Executive Secretary, 545 Munsey Bldg., Washington, D. C.
Sixteenth annual convention, January 27-29, William Penn Hotel, Pittsburgh, Pa.

National Slag Association; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

National Terrazzo and Mosaic Association; U. F. Durner, Secretary, 815 West St. Paul Ave., Milwaukee, Wis.

Northwest Concrete Products Association; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

Portland Cement Association; Edward J. Mehren, President; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

Rail Steel Bar Association; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

Wisconsin Concrete Products Association; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

New Books and Pamphlets

Compressive Strength of Concrete in Flexure

Compressive Strength of Concrete in Flexure as Determined from Tests of Reinforced Beams. By W. A. Slater and Inge Lyse. Published by the Institute of Research, Lehigh University, Bethlehem, Pa., as an authorized reprint from the 1930 *Proceedings* of the American Concrete Institute. Paper cover, 44 pages, 6 by 9 in. Price 20 cents.

From the results of these tests the beam-cylinder strength ratio was found to vary with the strength of the concrete, the ratio decreasing as the strength increased. The compressive strength of the concrete in the beams, as computed by the straight line formula, was about 25 per cent greater than the compressive stress developed in 8 by 8 by 12-in. prisms loaded at the edge of the middle third of the cross-section.

Design of Road Slabs

Design of the Reinforced Concrete Road Slab. By L. E. Grintner, professor of structural engineering. Published as Bulletin No. 39 of the Texas Engineering Experiment Station, of the Agricultural and Mechanical College of Texas, College Station, Tex. Paper cover, 6 by 9 in., 88 pages. Illustrated.

The author presents a method of design for a new type of concrete road slab which, it is believed, will under certain conditions offer advantages over present-day types. Steel reinforcement is employed in both the top and the bottom of the slab.

Investigations on which this design is based were started in the summer of 1929 as a part of the work of the Texas Engineering Experiment Station. Later, during 1930, the work was carried forward to completion by the author on his own initiative.

Lime Mortar Publication

Lime Mortar: Its Relation to Water-Tight Masonry is the title of a new 35-page publication issued by the National Lime Association, 927 Fifteenth St., N. W., Washington, D. C.

The pamphlet contains a detailed discussion of the various properties of mortar and other factors which influence the quality of masonry.

Recommendations pertaining to mortar mixtures are summarized in a table of proportions of lime, cement and sand for various types of masonry, for different types of construction, and for variations in conditions of loading.

Highway Report

Arkansas State Highway Commission, Ninth Biennial Report. Published by the State Highway Commission, Little Rock, Ark. Stiff paper cover, 207 pages, 8 by 10½ inches.

Construction methods and costs, comparative cost data, materials and tests, bridges and maintenance, are some of the subjects treated in this well printed report.

Bronze-Weld Develops Strength of Concrete Pipe Reinforcement

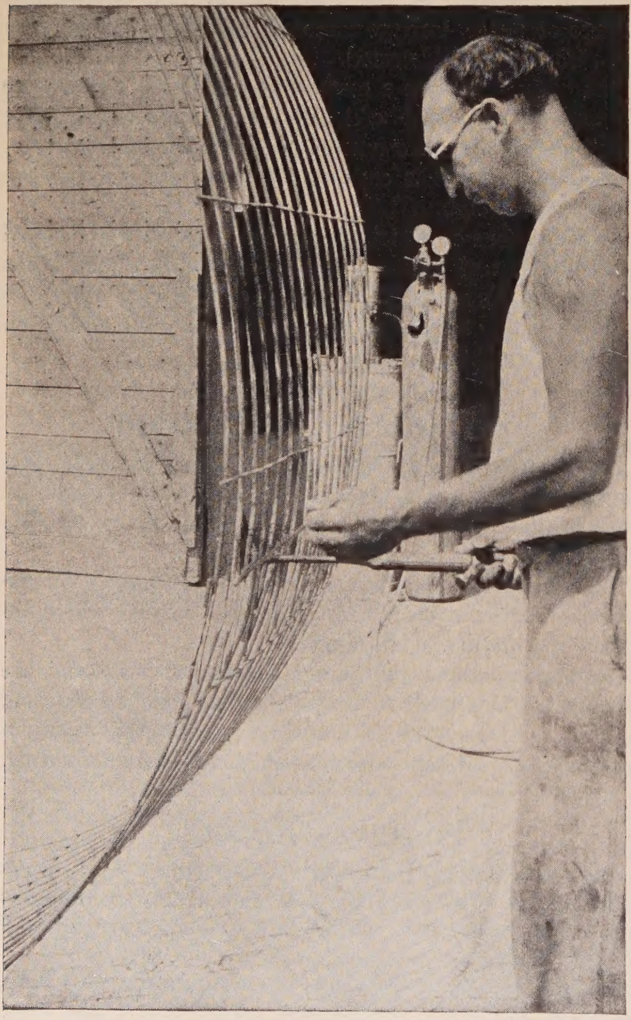
Only Small Investment Required for Blowpipe Equipment — Now Applied to Pipe of Large Diameter

THE oxy-acetylene welding process has been used for some time in the manufacture of reinforcement forms for small and medium diameter concrete pipe with outstanding results, but it was only recently that it was introduced into the field of large diameter concrete pipe manufacture. This was brought about through a succession of events that thoroughly convinced a certain manufacturer of the many inherent advantages of the blowpipe when applied to production as well as for maintenance and repair work.

Concrete pipe forms had been made for years in this plant by methods that required high initial investments. Although the steel reinforcements were produced at a low cost, the joints were weak and did not hold together well. Many corrective plans had been tried, but all had proved unsatisfactory when placed in operation.

The oxy-acetylene process was first introduced there as a maintenance unit, and in this capacity it was unparalleled in speed and adaptability. Recently, an oxy-acetylene service operator was looking over the plant with a view toward increasing the utility of the welding outfit through reclamation and repair work that had possibly been overlooked by the plant welder. During conversation with the manager, some of the persistent difficulties of reinforcement fabrication were mentioned. The problem of joining the bars together with a sufficiently strong bond was discussed at length.

The service operator suggested the use of the oxy-acetylene blowpipe and high strength bronze welding rod as a means of overcoming this problem.



Fabrication of pipe forms by bronze-welding process

A few experiments convinced the superintendent that bronze-welding would accomplish what had been sought, namely, welded joints that developed practically 100 per cent of the steel bar strength, a reduction in necessary equipment, and substantial economies in operation. The work was tried out in actual production with splendid results.

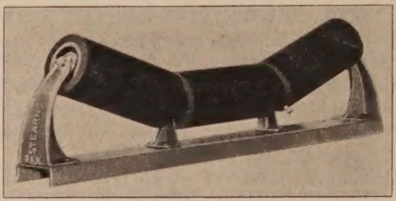
Consequently fabricating these steel forms by means of the blowpipe is now standard practice in this mill. In order to bronze-weld the pipe forms on an efficient production basis, suitable jigs were made so that the bars could be properly lined up parallel to each other and the proper distance apart. The bars are securely fastened in the jig, bent into circles, welded together, and removed to the yard where another welder attaches the struts that strengthen the forms and make them rigid throughout.

This method of fabrication is a decided success from many viewpoints. The initial investment for equipment was small, requiring only the purchase of suitable blowpipes for the work. The high-strength joints were obtained at no sacrifice of speed in production. Strength, economy, and ease of joining were of paramount importance, of course, and were all efficiently accomplished by using bronze-welding as a means of joining the assembled reinforcement bars.

Stearns Company Gets Hoover Dam Belt Conveyor Order

An order for one and a half miles of belt conveyors has been received by the Stearns Conveyor Co. of Cleveland, a subsidiary of the Chain Belt Co., Milwaukee, for construction work on the Hoover dam. The order consists of approximately 1,200 troughing and return idlers.

These idlers will be of the Rex-Stearns unit casting closed-head type, especially designed for the severe handling service represented by the rock and gravel industry. Thirty-inch belts and smaller will be built in the 3-pulley type of construction and 36-in. and 42-in. sizes will be furnished in the 5-pulley type of construction.



Rubber-covered idlers to be used on Hoover dam job

The gravel plant at Hoover dam, which is to prepare the aggregates for later construction, will be located at Boulder City, Nevada, and will, during the course of the construction work on the dam, handle approximately eight million tons of sand and gravel. Rex-Stearns rubber-covered idlers will be used at the loading points to reduce belt wear to a minimum.

Vibrastone Folder

Vibrastone—"a scientifically manufactured product, unlike any other stone"—and recently further improved, is described in an 8-page file folder just issued by the Benedict Stone Products Co., Chicago, Ill., which is allied with the Massey Concrete Products Corp.

Eight reproductions are shown in exact colors.

The Benedict company is now engaged in building a new plant in the Clearing Industrial district for the manufacture of Vibrastone, replacing the plant which has for years produced Benedict Stone. Scientific methods hitherto unknown in such work are to be used and special equipment is being provided throughout the plant.

New Equipment and Materials

Some Types and Uses of Branford Vibrating Equipment

Forms for monolithic wall construction, pipe, burial vault and cast stone are a few of those on which Branford vibrator equipment may be used to secure the benefits of vibration.

A unit particularly applicable in concreting is the continuous operating type, made for bolting into any type housing that is machined to fit the attaching heads, to be mounted vertically or at 45 deg.

A special device is also available for the removal of laitance and other extraneous matter.

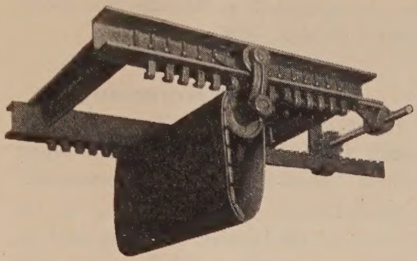
Vibrator tables, mold vibrators and slicing spades are available for use in the products plant. The table is held by a spring support at each corner and handles molds containing up to 2,000 lb. of concrete. The mold unit is made in six sizes.

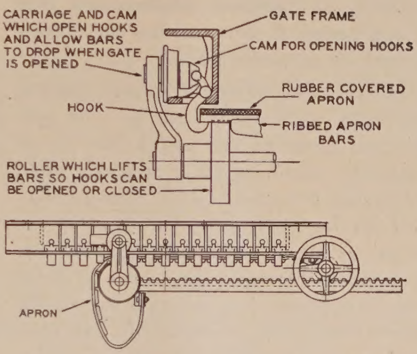
All units are operated by compressed air, at an optimum of 80 lb.

The Branford vibrator is very efficient, having all parts hardened and ground, is an instant starter, and, according to the manufacturer, with reasonable care will last indefinitely. It is a product of George B. Pickop, engineer of the Malleable Iron Fittings Co., Branford, Conn., from whom the vibrator and its attachments may be purchased outright, there being no royalties.

New Apron Gate Features Easy Operation

A new type of low friction Apron gate which is said to be compact, light-weight, inexpensive and easily operated by one man has been perfected by the Stephens-Adamson Mfg. Co., Aurora, Ill.




CARRIAGE AND CAM WHICH OPEN HOOKS AND ALLOW BARS TO DROP WHEN GATE IS OPENED
GATE FRAME
CAM FOR OPENING HOOKS
RUBBER COVERED APRON
HOOK
RIBBED APRON BARS
ROLLER WHICH LIFTS BARS SO HOOKS CAN BE OPENED OR CLOSED
APRON

The gate opening is closed by a series of reinforced cross bars, covered with a wear-resisting rubber apron. In closing the gate, these bars are lifted one by one and hooked into place. A rack and pinion moves the operating carriage backward and forward to open and close the gate.

In opening, the carriage is pulled backward, causing the two lower rollers to lift the apron bars slightly and disengage the hooks. In closing the carriage is pushed forward, the cams open the hooks, the rollers lift the apron bars into place, the hooks engage and the gate is closed.

A drain may be attached to catch surplus water.

In the upper view the Apron gate may be seen partially opened to show how the apron drops from under the load without friction. The drawings show how the apron bars are held in place, and how they are released when the gate is opened.

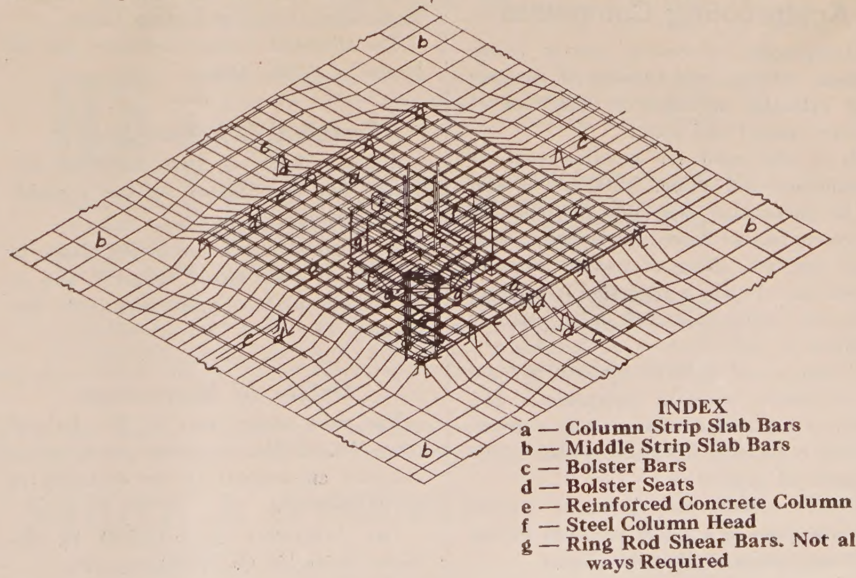
New Flat Slab System Omits Drops and Column Flares

A new flat-slab system of reinforced concrete construction, which omits visible drop panels and column heads, has been introduced by the Smooth Ceilings System, 1000 Metropolitan Life Building, Minneapolis, Minn.

In this system the area occupied by drop panels in ordinary flat-slab construction is, in fact, heavily reinforced with steel, but the reinforcement is kept within a shallower depth, so that no paneling is necessary.

The column flares of ordinary flat-slab construction are likewise replaced, in this design, by steel column heads that are kept within the depth of the floor slab. These steel column heads may be employed (in differing types) either with concrete-incased structural steel columns or with reinforced concrete columns.

The new system, on which patents are pending, was invented by Walter H. Wheeler, consulting engineer, Minneapolis.



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a — Column Strip Slab Bars
b — Middle Strip Slab Bars
c — Bolster Bars
d — Bolster Seats
e — Reinforced Concrete Column
f — Steel Column Head
g — Ring Rod Shear Bars. Not always Required

About Makers of Equipment and Materials

Industrial Literature

Masonite Presdwood Booklet

Masonite Tempered Presdwood for Concrete Form Construction is the title of a booklet now being distributed by the *Masonite Corp.*, Chicago, Ill.

It is a 14-page publication containing practical information on form construction with Tempered Presdwood and giving a set of general and master specifications for the use of the material on various types of reinforced concrete construction.

The manufacture and physical characteristics of Presdwood are also discussed.

Practice in Using Calcium Chloride for Curing Concrete

A valuable bulletin issued by the *Columbia Alkali Corporation*, Barberton, Ohio, under the title of *"Report on Current Practice in Using Calcium Chloride for Curing Concrete in Pavements, Building Construction, Bridges, Culverts and Concrete Products,"* deals with the use of this product in many classes of construction work.

The bulletin contains extracts and conclusions from all available practical reports from organizations such as the Highway Research Board, the U. S. Bureau of Public Roads, and many of the state highway departments who have been conducting experiments in this field. It also contains the report of the Tennessee investigation, one of the most thorough experiments in curing methods conducted to the present date.

Specifications are included for both the surface method and the integral method of curing.

The 12-page publication, 8½ by 11 in. in size, is designated as Bulletin No. 30-750, revised October, 1931.

Pavement Reinforcing

The Wire Reinforcement Institute, Washington, D. C., has issued a 40-page report entitled *"Reinforced Concrete Pavements."*

Welded wire fabric, according to the foreword of the booklet, has been used extensively as pavement reinforcement over a long period of years and has consistently proved its economic worth.

"It enhances pavement quality, assures minimum maintenance costs as time goes on, and prolongs the useful life of the pavement. Involving but a relatively small additional first cost, fabric reinforcement will pay for itself many times over by the actual saving in maintenance alone, not to mention the outstanding value of keeping the pavement in a generally better condition throughout its entire life and postponing, for many years, the time when resurfacing would otherwise be necessary."

Rubber Products

Various rubber products employed in the making or handling of concrete are cataloged in a new edition of the *Diamond Rubber Company's* new mechanical catalog.

Included are belting, hose of various types, chute lining and pump valves.

The Diamond Rubber Company, Inc., is located at Akron, Ohio.

Sectional Conveyor Folder

A 4-page folder on *Porta* sectional conveyors has been issued by the *Portable Machinery Co.*, York, Pa.

Units are shown in use in job plants, in delivery of ready-mixed concrete, and in a products plant. Specifications are also given.

Origin of Microscope

The most recent issue of *The Laboratory*, Vol. 4, No. 4, gives, among other subjects, an account of the evolution of the microscope.

The Laboratory is published by the *Fisher Scientific Co.*, Pittsburgh, Pa.

Modern Truck Mixer

"The Smith truck mixer for modern methods" is presented in a folder just published by the *National Equipment Corporation*, Milwaukee, Wis.

Built for heavy duty service this mixer and agitator is said to have such features as thorough five-step mixing action without reversing drum, no coning to the top, due to the egg-shape of drum and distinctive 12-panel design, and full control of discharge.

Autocars in Construction

A new publication of the *Autocar Company*, Ardmore, Pa., just off the press is *"Autocars for Construction Hauling."*

Its purpose is to convince "by means of external evidence that the men who are engaged in the tremendously important business of building—be it construction, demolition, excavation or what not—like Autocars and find them profitable to own."

NEW EQUIPMENT
(*Continued*)

Acitite Is New Concrete Acidproofing Compound

Acidproofing of cement mortar joints, cement coatings, and capping of concrete test cylinders are some of the uses of Acitite cement and paint.

It is also used for grouting concrete foundations and anchor bolts, and is said to be particularly adaptable for repairing defective cement floors, waterproofing footings, pits, etc., lining or making joints in sewer tile. Its use is suggested for glazing concrete roofing tile and other concrete surfaces as well.

Acitite is said to be 100 per cent immune to sulphuric, muriatic, hydrochloric and other strong acid solutions. It is a quick-setting compound, hardening within a few minutes of application.

Further details and directions for its use are given in a leaflet prepared by the Sullivan Company, Memphis, Tenn.

Manufacturers' News

Barber-Greene Sales Manager

The Barber-Greene Company of Aurora, Ill., manufacturers of material handling equipment, announce the appointment as general sales manager of *F. D. Hooper*, formerly sales manager of the Lidgerwood Manufacturing Co., of Elizabeth, N. J.

He was employed by the Lackawanna Steel Company (now Bethlehem Steel) and the Boston and Maine Railroad before starting his twenty-four years of continuous service with the Lidgerwood Company.

Penn Co. Sales Manager

The H. O. Penn Machinery Co., Butler Bin distributors located at 140th Street and East River, New York City, announce the appointment of Jack Conway as sales manager.

He was sales manager for the Complete Machinery Co., New York City; Hunter Machinery Co., Pittsburgh, and the Leach Mixer Co., Oshkosh, Wis.

Heltzel Installs New Machinery

The Heltzel Steel Form & Iron Co., Warren, Ohio, is completing the installation of machinery and equipment in its recently completed addition.

This is an outward expression, according to President J. N. Heltzel, of the company's confidence in the future.